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ABSTRACT

The Calgary Board of Education and the Calgary Catholic Board of Education developed indicators of quality student performance for the assessment of school art composition and mathematical problem solving. Practicing teachers and school system specialists in art and mathematics developed and classroom-tested materials to identify and document educational quality indicators (EQIs). The resulting qualitative materials describe a performance assessment process which celebrates diversity in student responses. The process depends on informed professional judgment, shared exemplars and vocabulary, and student involvement in self-assessment. This report describes the beginning and development of the project, the rationale and literature that informed the work, and the apparent impact of the project, as it evolved from September 1989 to May 1992. The project results to date indicate that performance assessment has positive effects on learning and teaching, and that further explorations and applications of the quality indicators project would be educationally significant. Appendixes provide the names of project participants; EQI-Art Materials and Reports; EQI-Math Materials and Reports; and an evaluation of project utility, management, and impact. (Contains 53 references.) (Author/LL)

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Educational Quality Indicators in Art and Mathematics

Calgary School District No. 19
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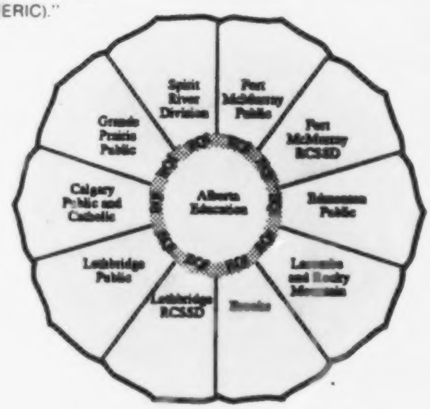

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Educational Quality Indicators in Art and Mathematics

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and Calgary RCSSD No. 1

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EQI Art Advisors
EQI Art Teacher Researchers
EQI Field Test Teachers
EQI Art Pilot Teachers
EQI Math Advisors
EQI Math Teacher Researchers
EQI Math Pilot Teachers
EQI Project Steering Committee
EQI Local Advisory Committee

ABSTRACT

The Calgary Board of Education and the Calgary Catholic Board of Education have developed indicators of quality student performance for the assessment of school art composition and mathematical problem solving. Practising teachers and school system specialists in art and mathematics have developed and classroom-tested materials to identify and document quality indicators. The resulting qualitative materials describe a performance assessment process which celebrates diversity in student responses. The process depends on informed professional judgement, shared exemplars and vocabulary, and student involvement in self-assessment.

This report describes the beginning and development of the project, the rationale and literature that informed the work, and the apparent impact of the project, as the project evolved from September 1989 to May 1992. The project results to date indicate that performance assessment has positive effects on learning and teaching, and that further explorations and applications of the quality indicators project would be educationally significant.

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CHAPTER 1: INTRODUCTION

This chapter describes the background and purposes of the Calgary Educational Quality Indicators (EQI) Project, along with the assumptions, definitions, and methodologies that characterize the project activities.

Background

In the Spring of 1989, officials from the Calgary Board of Education (CBE), the Calgary Catholic Board of Education (CCBE) and Alberta Education negotiated a contract as part of the provincial EQI Initiative that committed the parties to a collaborative project entitled "The Development of Indicators of Academic Excellence" (called the EQI Project or the "project" in this report). The purpose of the project was to develop and pilot test indicators of quality student work in areas of school art and mathematics. Personnel were identified and assigned to the project at the beginning of the 1989 - 90 school year.

The Alberta art curriculum includes depiction and composition from grades 1 through 12. Art is a compulsory course for students only in grades 1 to 6. Art achievement is often assessed in terms of student effort, attitude, participation or independent teacher professional judgement. There are no assessment devices available that were based on commonly understood expert standards regarding the quality of student artwork.

The articulation and communication of quality indicators in student artwork is intended to result in improved teaching behaviours and improved student learning. The project provides documentation of those observable qualities in student art which should be recognized and encouraged and which assist in the development of teacher expertise in the area of art.

Problem solving was selected for the development of quality indicators because of the importance of problem-solving skills in the mathematics program and because of a predicted transfer of the problem-solving practices to other subject areas. Problem solving in mathematics is both a specific content strand as well as a unifying construct for the entire program. This is evident in Alberta Education curriculum documents for elementary, junior high, and senior high school mathematics courses. The assessment of problem solving involves the examination of the thinking processes that underlie student answers to problems.

Traditional assessment practice in mathematics has been most concerned with the **product** or answer given. Mathematics teachers and curriculum experts encourage the assessment of problem-solving processes, but few materials were available to all teachers to assist in this task.

Context

Calgary is a city of 700,000 people located 100 kilometres east of the Rocky Mountains in central Alberta. There are two publicly-supported school systems to serve the urban area: the Calgary Board of Education, with an enrolment of over 94,000 students and the Calgary Catholic Board of Education, with an enrolment of about 30,000 students. The CBE and the CCBE are respectively the third largest and the twenty-fifth largest school systems in the country (Canadian Education Association, 1992). Both school systems provide subject area assistance to classroom teachers through central office specialists in most school subject areas. These specialists are involved in the organization and delivery of teacher inservice programs, the selection and development of materials to support teaching and assessment, and the recommendation of school system policies that affect their subject specialties. There is a long history of professional collaboration between the two school boards.

Rationale

The CBE and CCBE are committed to discovering and using the best possible ways to gather information about and report on student achievement in their schools. The EQI Project provided an opportunity to emphasize this commitment.

The CBE and the CCBE report on the achievement of individual students and of groups of students using a variety of techniques and materials. Some measures and reports about student achievement, such as the Student Achievement Tests and Diploma Examinations, are prepared and distributed by Alberta Education. Other information regarding student achievement is prepared and distributed by school system officials, by school administrators and by classroom teachers.

Most of the reports about student achievement are in the form of results on paper-and-pencil tests where there is a single correct answer. Student performances which are creative or original escape inclusion in traditional tests, although they are powerful indicators of student success. Student achievements in creative expression, critical thinking, and problem solving fall into this performance category. These complex student performances are difficult to report on using numbers, averages, and percentiles. Professional educators require new alternatives for assessing and reporting on student achievement that is demonstrated in complex performances.

This project addresses the lack of such alternatives through the development of quality indicators in art and mathematics.

Teachers and fine arts specialists in the CCBE had identified a need for assessment materials for the visual arts. They requested help with the task of identifying quality in the art works that students produce. This request formed the basis of one part of the EQI Project proposal. The contract developers were also aware of requests for assessment materials for problem solving in mathematics. Problem solving has recently become a very important element of mathematics courses throughout the grades, and teachers and students needed new materials to help demonstrate student achievement in this content area.

Purposes

The **purposes** of the EQI Project were the following:

- to identify indicators of quality work which can be applied in the assessment of student achievement in areas of art and mathematics,
- to identify conditions that appear to enhance or limit quality achievement,
- to develop strategies for collecting quality student work which include recorded interviews with teachers and students, and
- to examine quality work with emphasis on alternative assessment strategies to paper and pencil testing.

Assumptions

EQI project advisors and practising teachers appeared to have common understandings or assumptions about **learning, teaching and assessment** that served as a background from which to proceed with the project work. These three elements organize our assumptions.

About Learning

- There is a difference between information and knowledge, although students attain both as a result of schooling. Information refers to the content of the school curriculum that can be memorized and recalled for presentation. Knowledge, on the other hand, is the result of a student's making meaning out of information and experience. The possession of knowledge is demonstrated in the performance of tasks that challenge students to apply what they know to a new situation.

About Teaching

Teachers are responsible for providing students with learning experiences that assist students in making meaning and in practising their learned skills. The teacher is like a coach or mentor.

Teachers can identify quality in student work, although they may not all be able to articulate the characteristics that indicate quality, or communicate about these characteristics in the same way.

About Assessment

Traditional paper-and-pencil tests which require simple, single answers to highly structured situations cannot adequately assess student knowledge. Assessment practice has an impact on teaching practice.

Student performances include some unexpected responses. Teachers need to be able to analyze these responses, place them in context, and comment appropriately. Practising expert teachers can recognize qualitative differences among student performances.

Teachers and students can develop skills in "connoisseurship" regarding the performance of complex tasks. That is, they can develop "a highly differentiated array of anticipatory schema that enable one to discern qualities and relationships that others ... are less likely to see" (Eisner, 1985, p. 153). Samples of excellent performances can be used effectively to help develop connoisseurship skills.

Learners develop appropriate self-assessment skills with coaching and practice.

Definitions

In this project **quality indicators** are defined as **observable characteristics of excellence established through consensus of professional judgement among practising teachers.**

Assessment is gathering information or observable evidence of what a learner can do. **Evaluation** is making judgements based on interpreting assessment information. Assessment and evaluation are part of the teaching process.

Design

This project was designed as action research: we began with the experience of actual practice, and reviewed this experience to develop frameworks and proposals for further study. In this section, we briefly describe *activities, structure* and *evaluation* as these were shown in project design.

Activities

The project design incorporated three phases: development, field testing, and pilot testing, which correspond to the three years of project funding. Activities in the developmental phase included the review of the literature, establishment of committees, and preparation of initial structures for indicators of quality student achievement. Committees of teachers and subject specialists reviewed student work, identified characteristics of quality work, considered alternative approaches for recording assessment information, and proposed activities and materials for use in classrooms.

In the field-testing phase, project personnel tried a variety of materials and approaches in classrooms. Promising approaches were pursued and evidence of the results of field tests was collected. This evidence was used to revise the materials and to structure plans for pilot testing.

Pilot tests were carried out by teachers who had no previous experience with the EQI project. The pilot teachers tried out the assessment materials during their regular teaching practice and during specifically designed classroom activities. Project advisors provided inservice prior to piloting and support to pilot teachers during the pilot period.

Structure

Art and mathematics subject specialists from the two school systems provided advice, support and direction for the project. These specialists were the advisors to the project as well as participants in project activities.

Classroom teachers, identified by subject specialists for their expert classroom practice and professional commitment, provided the developmental work, the testing of materials in classrooms, and thoughtful reflections and evaluations. School principals approved each teacher's participation and then the teachers volunteered to participate. The first team of teachers was asked to work with the project for the first two years. Because much of their work was action research into their own practice, they are called "teacher researchers." Teachers whose primary role was to try out specific materials and practices in their classrooms are called "field test teachers" and "pilot test teachers." For every project task, the project teachers represented both the selected grade levels of the study and the two school jurisdictions.

Senior superintendents and education officials served on project steering committees that provided coordination between the two school jurisdictions and Alberta Education, and provided direction to the project manager. An advisory committee provided a communications link to other educational stakeholders. Members of the advisory committee included: university professors in art and in mathematics, leaders in the art and mathematics communities, parent representatives, teachers' association representatives, and members of the business community.

A local advisory committee — consisting of representatives from the University of Calgary, the Alberta Teachers' Association, parent councils in both school boards, the arts and mathematics communities, and the business community in Calgary — assisted in providing advice and feedback regularly throughout the project. The project personnel who formed the development, advisory and steering committees for the project are listed in Appendix A.

Evaluation

Project evaluation was both formative and summative throughout the project. The project evaluation plan was based on a "Context, Inputs, Process and Product" (CIPP) framework (Stufflebeam & Webster, 1988). This framework structures evaluation questions around the four issues: the contextual environment for the project, the input resources that were required and/or used in the project, the processes and activities that shaped the project, and finally, the products of the project and their perceived usefulness and value. Teachers and advisors regularly considered questions about the processes and products of the project. Their recommendations were used to make changes to activities and materials throughout the project.

Both quantitative and qualitative data were gathered about the effects of the project in classrooms. Many different information-gathering methods were used: students were videotaped and audiotaped during problem-solving and art-making sessions; written responses were requested; survey data were collected; and an external interviewer spoke with advisors. Quantitative data were collected regarding: teacher behaviours and beliefs about art and problem solving; student attitudes, dispositions and scores on problem solving; and teacher reports of practice and the impact of EQI-Math on their teaching. Qualitative data were collected regarding: teacher beliefs and practices in art and mathematics, before and after piloting; student responses to EQI materials; teacher and student journals in art; anecdotal records of student problem solving; descriptions of the mathematics classroom environments; changes reported by teachers as a result of using EQI materials; and impressions of the project formed by project advisors.

An external consulting agency completed a formal evaluation of project utility, management, and impact. This evaluation is found in Appendix D.

In this report, data from more than one source have been used to develop conclusions and recommendations. The accumulated data have not all been analyzed at this time. However, original data have been maintained in project archives for future reference.

Scope

The art component of the project (EQI-Art) focused on the depiction and composition components of the Alberta Education art curriculum insofar as these are displayed in completed student art works. Student art works from grades 2 and 5 are the elementary exemplars. At the junior and senior high school levels, art works reflect all grade levels, because many schools offer only one art course or offer courses for students from any of the three grades in that division.

EQI-Math focused on problem solving, which is both a content area and a method of teaching in the Alberta Education mathematics curricula. Grades 2, 5, 8, and 10 were selected to provide a representative sample of student achievement for the EQI Project. Grades 2, 5, and 8 are midway through each of the school levels — primary, late elementary, and junior high. Grade 10 was identified in place of grade 11 because there was a new curriculum implementation affecting grade 11 mathematics courses during the EQI Project years.

Limitations

School system specialists identified successful, professionally involved practising teachers for the EQI Project. School principals approved each teacher's participation and then the teachers volunteered to participate.

Twenty-six practising teachers from the CBE and the CCBE were teacher researchers during the initial phase of the project. Another 24 teachers field tested or pilot tested project materials in their classrooms. These 50 teachers represent a very small percentage of the more than 5,000 classroom teachers in the two school systems.

Teachers piloted the project materials in 16 schools during the first half of the 1991-92 school year. Two classes at each grade level pilot tested the EQI-Art and EQI-Math materials. This is a very small pilot test, limited by the resources available for the project. The project teachers were selected because of their expertise and commitment to professional development. This fact may limit the transfer of experiences from these teachers to the population of teachers in general.

Overview

This chapter has described the background to the Calgary EQI Project, its purposes, the organization and scope of the project. Chapter 2 includes a discussion of the related literature and concludes with the implications of the literature for the structure and activities of the EQI Project. Chapters 3 and 4 discuss the activities and findings from the EQI-Art and the EQI-Math projects respectively. Chapter 5 brings the two projects together with a discussion of the findings of the project as a whole and recommendations for future activities.

CHAPTER 2: RELATED LITERATURE

The teachers and advisors working on the EQI Project began their work based on their personal practical knowledge of schools and schooling. The project coordinator responded to and supported the committee deliberations by compiling literature of interest to the committees in the areas of *learning, teaching* and *assessment*. The following discussion incorporates the key aspects of that literature, and concludes with **implications** for the EQI Project.

Learning

The EQI Project developed new materials for the assessment of student learning in areas of art and mathematics. The understanding about learning is an important basis for the project's work. This section addresses this understanding in two subsections: 1) from the perspective of **goals of education** and **schooling**, and 2) as part of the **view of learning in cognitive theory**.

Goals of Education and Schooling

The aim of education in Alberta is to develop the knowledge, the skills, and the positive attitudes of individuals, so that they will be self-confident, capable and committed to setting goals, making informed choices and acting in ways that will improve their own lives and the life of their community (Alberta Education, 1991).

The learner is expected not only to **have knowledge** but also be able to **use knowledge** in significant ways. "What matters is not that one can read, but rather that one does read and that what one reads is worth reading" (Eisner, 1983, p. 49). Alberta's goals of secondary education specify that schools will assist students to accumulate a wide variety of knowledge and skills, and also intend that students:

- develop the ability to think conceptually, critically and creatively; to acquire and apply problem-solving skills; to apply principles of logic; and to use different modes of inquiry;

- assume increasing responsibility for independent and continuous learning, and develop positive attitudes toward learning while in school, in preparation for self-directed, lifelong educational experiences (Alberta Education, 1991, p. 4).

Educators and others often use the term "literacy" in defining the goals of education. Discussions about literacy reiterate the message that the possession of "basic" skills is insufficient. Resnick and Klopfer (1989) extend literacy into **"competent thinking."** For the Calgary Board of Education (1989), literacy is a necessary condition for personal growth, including the abilities people have to understand and to participate and communicate in the communities in which they find themselves. Greene (1983, 1990) speaks of literacy as an ability to extend personal power over symbols and knowledge in a whole range of intellectual environments, the arts and technologies, literature, politics, and social relationships.

Definitions of mathematical literacy imply a similar set of objectives, extending from the development of technical mathematical proficiency to the ability to understand and appreciate the contributions of mathematical concepts to everyday decision making, to culture and to civilization (National Council of Teachers of Mathematics, 1989).

Cognitive Theory

Currently, **learner's thinking skills** have become a focus of research study in education. Modern cognitive theory asserts that "people are not recorders of information but builders of knowledge structures" (Resnick & Klopfer, 1989, p. 4). Learning is a complex, meaning-making activity that can have many representations, depending on the skills, experience and environment of the learner. Both art making and mathematical problem solving are depicted as this kind of learning. Visual art is the observable result of cognitive decision making, and its production combines perception, use of visual symbol systems, technical skill, cultural appreciation, and emotion (MacLeod, 1989). Essays on the processes of problem solving (Charles & Lester, 1987; National Council of Teachers of Mathematics, 1989; Schoenfeld, 1989) emphasize the complexity of the process, including logical cognitive processes as well as collaboration with others, dispositional factors, and other environmental interactions in the depiction of problem-solving skills and processes.

Cognitive theorists and educators endeavour to understand what is happening in the mind of the learner. Norris (1989) suggests that teachers need to take the extra time to go beyond the student answer and to encourage critical thinking. He points out the usefulness of talking to test-takers, encouraging them to reflect and reason about their answers. Gardner (1991) encourages the development of expert understanding in learners, rather than settling for "correct-answer compromises" which may cover up a lack of significant understanding. Skemp (1989) considers the difference between teaching for "instrumental understanding" which expects that students have formulas or habits of thought, and teaching for "relational understanding," which requires that students develop conceptual structures to guide thinking about mathematical concepts. He calls on teachers to first understand concepts children hold, and then to help them build new, more appropriate schema.

Metacognition, or how students evaluate and control their own thinking is expected to be systematically developed in schools (Romberg & Carpenter, 1986; Schoenfeld, 1989). Snow (1989) provides a model for research on assessment that includes these metacognitive processes and recommends assessment models that capture higher order cognitive skills and conative structures. Processes of metacognition engage the student in self-assessment and self-regulation. Schoenfeld (1989) describes this engagement as part of that understanding that leads to mastery. The major goal in mathematics should be teaching "power" or higher order thinking skills. He encourages the use of coaching techniques when working with students on problem solving in the belief that students can be taught to regulate their own thinking through metacognition.

Teaching

The teacher is the critical factor according to much of this research, which calls for the teacher to arrange learning environments and activities which "stimulate and nourish students' own mental elaborations of knowledge and to help them grow in their capacity to monitor and guide their own learning and thinking" (Resnick & Klopfer, 1989, p. 5). In this view of learning, teacher expertise becomes increasingly critical to student achievement. This section addresses how the conceptions of teaching have changed to value the teacher as **reflective practitioner** and as **mentor** and **coach**.

Reflective Practitioner

As expectations of education are sorted out in the political process, and as research provides information about relationships within the education process, paradigms or persistent pictures emerge of the educational reality that change only gradually over time. Shavelson (1988) and Brophy and Good (1986) document three paradigms that have been used to understand the teaching process: the "trait conception" of good teaching which connected performance with the appearance of personal characteristics in the teacher in the 1940s and 1950s; the "skills conception" of good teaching which focused on the microteaching skills and a repertoire of competencies for instruction in the 1960s and 1970s; and the "reflective practitioner" conception of teacher that places the teacher as mediator in the process of student construction of knowledge in the 1980s and now into the 1990s.

Clark and Peterson (1986) describe the emergence of the view of the teacher as reflective practitioner to replace the notion of teacher as skilful technician. This view is consistent with the teacher as clinician and action researcher, which is evident in the work of Duckworth (1986), Goodlad (1986, 1987), Clandinin (1986), Calfee and Hiebert (1988), Costa (1989), Shavelson and Stern (1981), Sirotnik and Clark (1988). Teacher thinking, as conceptualized in this body of research, is a central set of moderating contextual factors that influence curriculum effectiveness, school effectiveness, and student achievement. Teacher thinking must be the focus of teacher development practices at all levels in education.

> If we wish to develop intelligent behaviour as a significant outcome of education, instructional strategies purposefully intended to develop children's metacognitive abilities must be infused into our teaching methods, staff development and supervisory processes (Costa, 1984, p. 58).

Mentor and Coach

Duckworth (1986) encourages teachers to put students in direct contact with phenomena to be studied and to understand the sense students are making. She suggests that mentoring and coaching students, as a partner in their learning, has important, very desirable results. First, students gain clarity of thought by explaining themselves to others. Second, they determine for themselves what they want to learn. Third, students come to depend on themselves, they become the judges of what they know and believe. Fourth, students recognize the powerful experience of having their ideas taken seriously. Fifth, students learn an enormous amount from one another. In this process, learners come to recognize knowledge as a human product, and to be self-confident about learning.

Assessment

Assessment is the process of gathering information or observable evidence of what the learner can do. This section examines **functions, need for change, some alternative approaches,** and a **systems approach** related to assessment.

Functions

The root word of assessment means to "sit with" a learner, paying close attention to the evidence of a learner's thoughtful understanding. "And thoughtful understanding implies being able to do something effective, transformative, or novel with a problem or novel situation" (Wiggins, 1989, p. 34). The background from which a teacher can make appropriate assessments is rooted in that teacher's deep understanding and abilities to communicate that understanding to students. Eisner (1985, 1991) defines that deep understanding as connoisseurship — the ability to perceive subtle qualities and nuances not available to most. The connoisseur must then use criticism, which is" ...[the] art of saying useful things about complex and subtle objects and events so that others less sophisticated or sophisticated in different ways, can see and understand what they did not see and understand before" (1991, p. 3).

Resnick and Resnick (1985) discuss assessment and curriculum as the two key components that can be changed to effect school improvements. The evidence and common sense tell us that what is assessed will be taught. Although the practice of teaching to the test may be frowned on in educational circles, as Nickerson (1989) says, "frowning on a practice has seldom been an effective deterrent if the incentives to engage in it are strong" (p. 3). The incentives to increase test scores are substantial, propelled by competition for resources and increased scrutiny and criticism of the educational enterprise.

Need for Change

One key issue in discussions about assessment is encapsulated in the statement: "American children are the most tested in the world and the least examined" (Resnick & Resnick, 1985, p. 17). Their intention is not to eliminate testing, but rather to improve tests so that they demonstrate real achievement, what we want students to know as a result of schooling. Assessment determines what teachers teach, states Wiggins (1989), so instead of trying to fight that tendency, educators should concentrate on developing effective tests that examine those competencies they think are essential.

If the goals of education are broad, then the tests used to assess achievement must address this breadth (Hargreaves, 1990; California Assessment Program, 1989). A reliance on only one form of assessment, such as the multiple choice test, cannot do the job fully. There is an extensive body of expressed concern over the exclusive use of multiple choice testing, most often highlighting the problems of teaching to the test, ignoring untested curricula, segmenting knowledge, "decontextualizing" knowledge, and downplaying the role of the teacher as professional (Archbald & Newmann, 1988; Murnane & Raizen, 1988; Resnick & Resnick, 1985; Wiggins, 1989).

Teaching includes the diagnosis of learning concerns and the development and implementation of activities to address these. As part of the teaching process, assessment practices must provide information to help with diagnosis and development activities. Assessments must contain the information, and teachers must understand and use the information to make decisions. In the assessment of self-regulatory and motivational activities of learners, Snow (1989) states that some teachers know how to assess learner outcomes in these areas informally, and research faces the considerable task of refining tools for use by teachers and others to formalize and improve this measurement. Assessment instruments need careful design, need to be developed by professionals in education, and assistance with interpretation must be available to those who use the information.

Some Alternative Approaches

Performance assessment alternatives are suggested as a means to assess higher order thinking skills and to broaden assessment processes. These alternatives are encouraged in many subject areas and implemented through such vehicles as portfolios, extended performances and displays.

One example of performance assessment is the Arts PROPEL project, a long-term developmental project that involves the Educational Testing Service, Pittsburgh Public Schools and the Rockefeller Foundation (Gardner, 1989; Wolf, 1989b). The PROPEL project supports the development of performance assessment instruments to document artistic learning from late elementary to high school in music, art and expressive writing. Some of the main tenets include: teachers having deep knowledge in the subject areas; learning centred around meaningful, significant projects which may involve students for a significant period of time; assessment as crucial, but respectful of the intelligence being assessed. The term PROPEL is an acronym for the three competencies to be assessed: production, perception, and reflection. Other examples of performance assessment in the arts recommend portfolio assessment for a variety of functions to foster artistic critiques, aesthetic reasoning, and to recognize the personal values espoused in artistic expression (Gardner & Grunbaum, 1986). Wolf (1989a) recommends portfolio assessments to promote characteristics such as increased student responsibility, an enlarged view of what is learned, recognition of personal progress, and the emergence of a developmental point of view.

Systems Approach

Education is a system of interactions, rather than a linear process of cause-effect relationships. Instead of controlling for the influence of teaching to the test, or practice effects, Frederiksen and Collins (1989) encourage educators to take advantage of "systemic validity," the direct and expected connection between instruction and assessment. "A systemically valid test is one that induces in the educational system curricular and instructional changes that foster the development of the cognitive skills the test is designed to measure" (p. 27). A test would be systemically valid only if it caused improvement in those skills it was designed to measure after it was in place for a certain period of time.

Frederiksen and Collins (1989) identify the directness of cognitive assessment and the degree of subjectivity or judgement required as important characteristics for systemically valid tests (p. 28). Direct assessment means that the cognitive skill that is of interest is directly evaluated as it is expressed in the performance of some extended task. This "directness" is the underlying tenet of performance assessment (Stiggins, 1987, 1988), authentic assessment (Wiggins, 1989; Calfee & Hiebert, 1988; California Assessment Program, 1990), and portfolio usage (California Assessment Program, 1990; Wolf, 1989a, 1989b).

The degree of subjectivity refers to the degree to which judgement, analysis, and reflection is used in assigning a score to a test performance. Frederiksen and Collins (1989) recommend subjective assessment for the development of materials to assess student performances, and the implementation of collaborative systems for marking and moderating student work. They say:

> Although it is worthwhile to develop objective tests of important cognitive outcomes, in general the state of the art does not permit objective tests for directly measuring higher order thinking skills, problem-solving strategies, and meta-cognitive abilities such as those involved in teaching, writing, and 'doing' mathematics (p. 29).

The training materials for subjective assessment help to communicate to teachers and students the critical traits to look for in examining their own or other's work. This communication function is a central component of the testing procedures of the Assessment of Performance Unit in Britain (Joint Matriculation Board, 1984), and the California Assessment Program (CAP, 1990) and the Benchmarks program in Toronto (Toronto Board of Education, 1989).

Components of a systemically valid testing system would include a set of tasks, a specification of primary traits of both process and product that the assessors know are learnable, a library of exemplars, standards, and a method for fostering improvement on the test, including such activities as student practice (Frederiksen & Collins, 1989). This assessment system fits the practical descriptions of the testing programs noted in Britain, California, and Toronto, and is a useful format for the development of alternative assessment techniques in the EQI project.

Implications for EQI Calgary

The Calgary EQI Project addresses the cognitive outcomes in the problem-solving strand of mathematics and in the depiction and composition objectives of art. These two sets of outcomes represent particularly difficult challenges for assessment because of the diverse nature of the student outcomes and the expectation that the professional judgement of educators will be central to completing the assessment. The literature describes the need for changes to accommodate what we know about learning, teaching and assessment, and provides us with some promising new approaches for developing new assessment practices.

The **need for tests that do a better job of assessing thinking skills** is widely recognized. The making of visual art and the solving of problems in mathematics both require complex thinking skills. Strategic flexibility, adaptive control, and achievement motivation are demonstrated in problem solving (Snow, 1989; National Council of Teachers of Mathematics, 1989; Schoenfeld, 1988; Murnane, 1988). A similar set of cognitive processes is suggested in the literature regarding the production of visual art (Glenn, 1989; Wolf, 1989a). Research reviews (Norris, 1989; Siegler, 1989; Nickerson, 1989) suggest positive directions for improvements to testing methods used currently and for the development of new instruments and strategies to apply what is now being discovered about cognitive operations.

Promising approaches that link the assessment process with instructional processes and focus on the development of teacher skills and judgement are under way in many formats around the world. Some programs of this nature are formal programs instituted by governing agencies and some are simply individual teacher assessment activities. Psychometric researchers (Snow, 1989; Nickerson, 1989) and educators involved directly in school change efforts (Wiggins, 1989; Stiggins, 1988; Gardner, 1989; National Council of Teachers of Mathematics, 1989) present a consistent emphasis on the development of teacher expertise in the process of improving assessment, both in external assessment developed by governing agencies and in teacher developed testing.

A "systems approach" to assessment such as described by Frederiksen and Collins (1989) provides a model to accommodate the demands of assessment in the production of visual art and in mathematical problem solving. First, the systems model adopts a **view of learning as a complex meaning-making activity** that has many representations, depending on the skills, experience and environment of the learner. Second, assessment is facilitated by a teacher whose **informed professional judgement** is essential for the assessment of student cognition. Third, assessment is focused on the **actual behaviours** that demonstrate the accomplishment of the learning objective intended, often the extended response to a complex challenge or problem.

CHAPTER 3: EQI-ART

> Images are records of created meaning ... the image is an attempt of the mind to penetrate the meaning of the world and the meaning of being human within it. Even in the most primitive attempts at the symbolic language of images, there is evidence of a mind at work: selecting, rejecting, arranging, creating: inventing the clothing for the idea.
>
> MacLeod (1989, p. 7)

Introduction to EQI-Art

Student outcomes in response to the depiction and composition objectives of the Alberta Education art curriculum are observed in the art produced by students. However, there are currently no assessment devices available that are based on commonly understood expert standards regarding the quality of student artwork. The EQI-Art project was designed to fill this void, by developing quality indicators that assist both teachers and students in their respective tasks of teaching and learning.

The EQI project has defined quality indicators as observable characteristics of excellence established through consensus of professional judgement among practising teachers. The EQI-Art project provides documentation of those observable characteristics in student art which should be recognized and encouraged and which assist in the development of teacher and student expertise in art. It was designed as collaborative research involving eight expert art teachers (EQI-Art teacher researchers), four art specialists (EQI-Art Advisory Committee), and sixteen practising art teachers (field test and pilot teachers). The list of the participants in the EQI-Art project appears in Appendix A.

Quality indicators of student art revealed through collegial exchanges of expert professional judgement are the focus of the project. Two primary considerations underlie the EQI-Art project research and development: the description of student artwork that demonstrates quality, and the development of teacher expertise in identifying quality work in the visual arts.

Student Art Work

Through the examination of student work we expect to document observable characteristics on which student performance should be properly judged. Curriculum guides and support materials typically contain significant detail regarding content to be mastered, skills to be practised, activities to be engaged in, and resources to be made available. Expectations regarding quality outcomes, however, are practically non-existent, leaving one with the possible interpretation that quality outcomes do not really matter much, that the process of engagement alone is most important. Or, more positively, the impression is given that teachers have the ability to assess quality performance in art and do not need assistance in curriculum documentation.

Teacher Expertise

This second consideration is the core of student assessment in art, although the issues are somewhat different in elementary and secondary programs. In elementary schools there are few art specialists, and the majority of elementary teachers are teaching and assessing student performance in art courses with little expertise or training in art. In the secondary schools, there are proportionately more art teachers with expertise and training in the subject, and the elective nature of the school programs may encourage better performance simply due to the element of choice. However, the consistency of performance expectations, particularly through the collaboration of professional thinking, is not systematically provided for in support materials available to these teachers.

The purpose of the EQI-Art project is to provide assessment devices that describe quality student performance in art, and do so in a manner that uses and develops teacher expertise. The project is founded on the principle that the articulation and communication of quality indicators for art production will lead to improved teaching behaviours and student learning. The following model depicts these ideas.

EQI-ART Model of Assessment

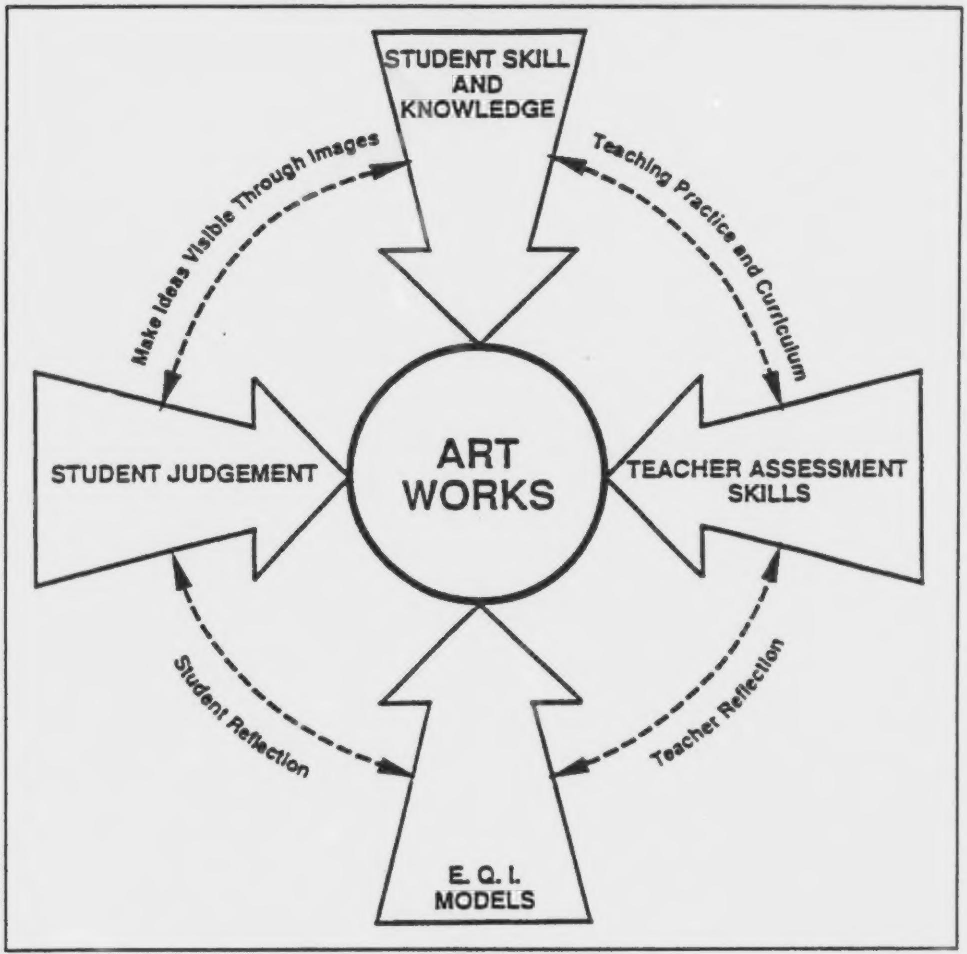
STUDENT SKILL AND KNOWLEDGE
Make Ideas Visible Through Images
Teaching Practice and Curriculum
STUDENT JUDGEMENT
ART WORKS
TEACHER ASSESSMENT SKILLS
Student Reflection
Teacher Reflection
E. Q. I. MODELS

Figure 1

The model presents the art work as the central result of the practice of student skill and knowledge, the application of student judgement, and the influence of teacher assessment skills and EQI models. The outer ring suggests the shaping interactions of teacher practice, reflection, curriculum content, and the students' desires to create significant images.
This model presents assessment as a rich and complex challenge that involves the teacher, the student, and the work.

Table 1 on the following page outlines the project personnel, tasks and results from 1989 to 1992. A sample of EQI-Art project materials is included in Appendix B.

Table 1: EQI-Art Project Outline

	Phase 1: 1989-1990 **DEVELOPMENT**	**Phase 2: 1990-1991** **FIELD TESTING**	**Phase 3: 1991-1992** **PILOT TESTING**
Personnel	school system art specialists (4) teacher researchers (7)	school system art specialists (4) teacher researchers (7)	school system art specialists (5) pilot teachers (8)
Tasks	categorized student art "above average," "average" and "below average" developed formats for assessing art: checklists, questions and narrative critique	removed categories of student art assessment to focus on "what is of quality in this work" described 3 quality indicators in narrative format: • relationships • handling • meaning field-tested handbooks, collected recommendations	prepared draft handbook to include all grades inserviced pilot teachers added teacher and student journals used handbook in classrooms for 4 months specialists visited all pilot teachers 2 or more times
Results	prepared 4 prototype "Quality Indicators Handbooks" • 2 or 3 sample lessons for grades 2, 5, 8 and 11 • lesson included teacher expectations, classroom conditions • student voice/intention added beside artwork developed criteria for 3 characteristics: • relationships of elements and principles of design • handling of the media • meaning or intention identified 5 categories of art: • directed observations • narrative works • responses to works of art • special communications of the self • design problems	4 handbooks: for grades 2, 5, junior and senior high recommended a SINGLE handbook — all grades included inservice and additional suggestions for use of handbook requested more examination of "thoughtfulness" encouraged	use of journals a key element for most pilot situations model of assessment practice well-received by teachers, students, parents and others expansion of single handbook: extensive introduction, more ideas for use of journals, reflective practices handbook edited and printed

Year 1: Development

In the first year of EQI-Art, teachers and advisors examined student art and identified characteristics of various levels of quality. Subsequently, several formats were developed for using this information in assessing art. There were four stages to the year's work: **1) identifying characteristics of quality, 2) raising concerns about predetermined characteristics, 3) preparing a framework for art assessment,** and **4) developing a prototype handbook.**

Identifying Characteristics of Quality

During the first project meetings in 1989, EQI-Art teacher researchers and specialists reviewed class sets of student art and clustered the works into "below average," "average," or "above average" groupings. In each cluster of student art, the teacher researchers and specialists then attempted to identify quality characteristics. Although there was a lot of agreement and consistency in the clustering, it was far more difficult to identify "observable characteristics" that indicated the quality of individual student work.

After reviewing many sets of student artwork, and categorizing each piece by its apparent quality, EQI-Art teacher researchers and specialists outlined some initial characteristics of quality that could be seen in student art works. The characteristics were:

- significant use of elements of design - colour, line, shape, space, value;
- application of the principles of design - "presentation," balance, organization, emphasis, repetition, variation, etc.;
- demonstration of technical control - appropriateness, competence, creativity; and
- evidence of thought - communication of a thought, emotion; complexity of work, novel use of symbol or medium.

For each of the characteristics, the teacher researchers and specialists developed comprehensive lists of observations that could be made about student art. Teachers tried out these lists in their classrooms and in project meetings. Teachers found the lists helpful in only a few instances. For example, the lists were helpful where the assigned art problem was very structured and limitations were imposed on media, size and technique. In some cases, however, the identified characteristics listed above were not seen to have any necessary connection with "quality" in the particular works.

It also seemed that a single set of characteristics was not sufficient for the variety of works students present. Therefore, a set of categories of artmaking — abstraction, working from observation or from memory, and personal expression or interpretation — were developed, within which more specific characteristics could be observed and outlined. These new lists were tried in classrooms and again, they proved to be of limited value.

The lists were then restructured into the form of questions that required the user to respond regarding each of the characteristics that could be seen in student art work. For example, questions included: "What are the methods used to illustrate depth?" "How is your attention drawn to the centre of interest?" and "How is unity achieved?" When reviewed by the teacher researchers, it was decided that this structure would be useful only for those teachers who have considerable background in art, and many teachers do not.

In attempting to provide sets of observable characteristics for several different types of artmaking, the group became frustrated with the constraints that were being established, and the unwieldy nature of the instruments. In addition, student art often did not strictly "fit" the four categories that had been defined.

Raising Concerns about Predetermined Characteristics

As a result of the concerns and frustrations with lists and questions, EQI-Art project committees felt that the checklists and sets of questions were not adequate to the task of assessing student artwork and the following concerns were raised:

- a comprehensive list of everything one could see in art works was virtually impossible to create because of the variety in art;
- if there were such a list, no teacher would have time to use it;
- a checklist style might cause teachers to concentrate on elements in the art that, while easy to observe, contribute little to the overall quality;
- a checklist approach might suggest that standardization is desirable in student artwork, and we wished to celebrate diversity;
- there is great variety among artworks that are all considered "superior," or "below average";
- teachers need assistance in learning to observe art, rather than a technical tool that will have limited applicability;

- it is important to include the intended meaning of the student artist in the practice of art assessment;
- to assess student artwork we must include the teacher intentions (or lesson presentation), and the classroom constraints; and
- categories of art that would better capture the diversity of student artmaking were suggested: observation, interpretation, response, special communication of the self, and design problems.

In response to these concerns, three basic criteria were established to provide a framework for observing quality indicators of student art:

- RELATIONSHIPS of the elements and principles of art
- HANDLING of the media used
- MEANING or artist's intention in creating the work

Five categories of art making were defined:

- DIRECTED OBSERVATIONS: such works include contour drawings, still-life, drawings from observed objects, from nature, from art, and from designed objects such as toys, machines, or tools, etc.
- NARRATIVE WORKS: these works show the student's response to ideas from language arts, social studies, sciences, etc. Any work that tells a story may be included in this category.
- RESPONSES TO WORKS OF ART: such images come from experiences of art works. Teachers will sometimes have students study the work of a particular artist like Van Gogh, or a special art movement like Impressionism, and then have students use such styles to make new images. Included are art works that result from the study of the art of other cultures.
- SPECIAL COMMUNICATIONS OF THE SELF: these are art works that reveal student's dreams, fantasies, deep feelings about experiences and/or social problems, and memories.
- DESIGN PROBLEMS: works in this category usually result from the challenge set by the teacher to create pattern, or to analyze balance, or symmetry, or to express ideas through special colour selections, i.e. warm and cool.

Preparing a Framework for Art Assessment

The EQI-Art personnel rejected the use of checklists for assessing student art work because this structure was too limiting for the variety of artwork presented, and because the checklist "style" did not recognize the effectiveness of individual professional judgement. A narrative style of assessment was selected — one which modelled expert professional judgement based on connoisseurship and educational criticism (Eisner, 1985). The expert judgement of practising art teachers was presented as a written critique individually prepared for each of the art works chosen by the project. The critique focused on the three basic criteria: relationships, handling, and meaning.

The quality of a work of art is found in the completed work itself, but the work comes out of a set of conditions that give it additional meaning for the viewer. In the educational setting, an understanding of these conditions provides teachers with increased understanding about the process of making and assessing art.

The identification of quality indicators in student art is practised within a school setting that consists of conditions — some of which can be largely controlled by the teacher and some of which are controlled by the student. These conditions are addressed in the EQI-Art project.

In order to assess student works of art, teacher researchers wanted to know more about the conditions under which the art was produced:

- what was the assignment?
- how much background do students have/receive to do the assignment?
- how much time was allowed?
- what materials did the students have available?

At the beginning of the project, EQI-Art teacher researchers brought in the work of their own classes and explained the conditions of the classroom assignment. Later, the teacher researchers at each grade level developed a joint lesson plan which was implemented and the results brought back to the committee. This latter plan was abandoned because the teachers found that lessons often had to be modified significantly because of resources available and student interests at the time. **Quality artwork seemed to arise from lessons that engaged students in the shaping of the background information and in the interpretation of the art problem itself.** The possible use of prescriptive lesson plans as a factor in the production of quality artwork was rejected as it did not fit the constructivist view of learning nor the belief in teacher professional judgement as the basis for educational decisions.

It was important, however, to know about the lesson that was presented in the classroom. With all samples of student artwork, we decided to provide a descriptive account from the teacher that included an explanation of the lesson, the teacher expectations, and the resources available (time, materials). A sample descriptive account from a grade 2 lesson follows:

Lesson:

The teacher challenged students to reflect that environments are altered by natural forces and to observe that shapes can suggest movement. Students were to observe examples of the changing patterns created by various objects moving through water and to note how light is reflected when water is moving.

Using oil pastels, the students were asked to depict movement through water. Students observed many examples from art and from the teacher's picture file.

Teacher Expectations:

The teacher expected that the students would:

- imagine an animal swimming through water
- create a two-colour oil pastel drawing showing how water changes when an animal swims through it
- make patterns that show light and shadow on the surface of the water
- indicate the movement of the water's wake

Resources:

Materials:	Coloured construction paper, 12" x 24" Oil pastels
Time:	Two 45-minute class periods in the fall term

Figure 2

Another condition for apprehending the quality of student artwork is the student intention in producing the art.

Teachers who know their students well can speculate and make quite accurate inferences regarding student intentions much of the time. The EQI-Art teacher researchers felt that asking students to provide intentions directly would provide valuable information for the teachers in assessing the artworks and might also be valuable for students in forming and clarifying their ideas. Some students were asked to write about their intentions and some were audiotaped and videotaped. The written form seemed to be most useful. Figure 3 presents an example from the grade 2 lesson described above.

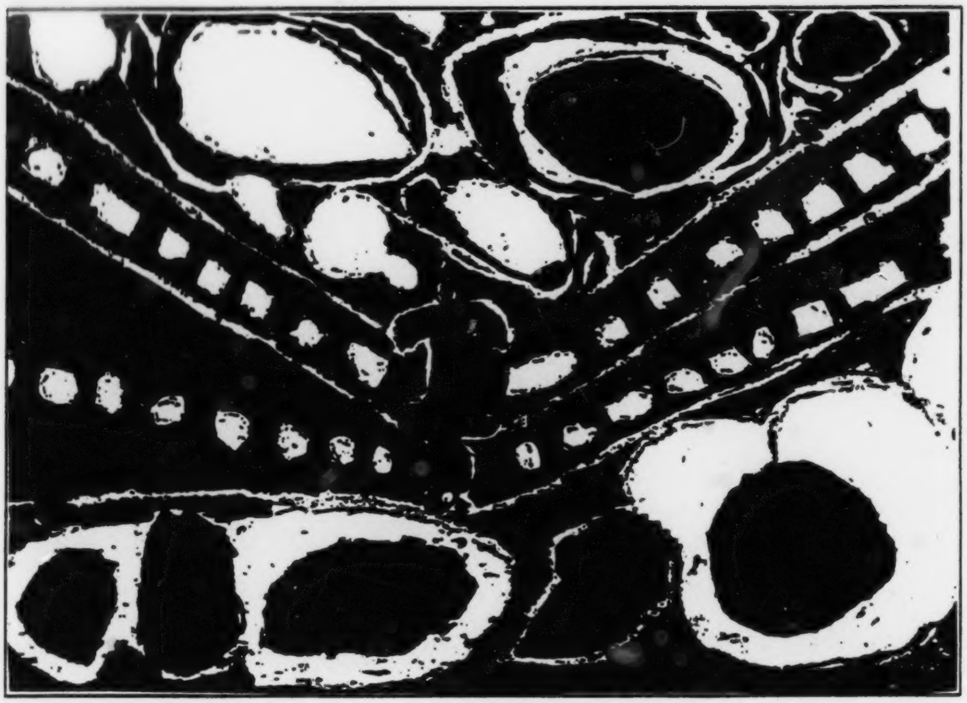

Figure 3

Student Intention:

I drew a beaver swimming in a pond. Because he is moving his feet the water is going away in a wake. I drew his leg and had to draw these waves because he was moving. I drew some big circles far away. They are things in the water that isn't moving.

Teacher Observation:

The beaver shape is almost centred while the page is divided into three horizontal divisions giving the work a feeling of order and balance. The colour reversals in the large shapes — dark red centres, white centres, some with borders, some without — are unusual and give variety and rhythm to these patterns.

The series of small white shapes arranged in orderly, double-diagonal rows on either side of the beaver sharpen the contrast and create a sense of movement by leading the eye to the central beaver shape.

The blue outlines and direction lines and the single-colour background make unity in the work.

Original is 12" x 18"

Figure 4

BEST COPY AVAILABLE

Developing a Prototype Handbook

Toward the end of the first year, the components of "quality indicators in student work" and "conditions of quality art production" were put together in the form of a prototype "Quality Indicators Handbook." The handbook reflects Eisner's model of connoisseurship and educational criticism (Eisner, 1985). **The intention of the handbook is to illuminate the process of assessment through modelling expert art assessment practice.** In order to provide this modelling, the handbook prototype contained teacher expectations, classroom conditions, and included colour reproductions of selected student work that expert art teachers would consider "superior," "above average," "average" and "below average." Each artwork was accompanied by student intentions and expert analysis focusing on **relationships, handling** and **meaning.**

The EQI-Art teacher researchers used and critiqued the prototype model, making a number of suggestions regarding improvement. Three very important suggestions were implemented.

First, it was recommended that we remove the qualifications "superior ... to below average," and present only those works that were of sufficient quality to allow extended critique regarding the quality present. Several factors were behind this recommendation. There was a concern that the presentation in published form of materials that would be held up as "poor examples" would detract from the emphasis on quality. A difficulty in copyright clearance in presenting student work in a negative light was also anticipated. Furthermore, the experience of the researchers suggested that by contemplating the organization of successful works, teachers would gradually build up a positive repertoire of quality indicators they could readily notice.

Second, the teacher researchers recommended that some kind of summary list appear in the document to provide teachers with a vocabulary for addressing the characteristics of "Relationships," "Handling," and "Meaning."

Third, there was considerable discussion regarding the value of providing handbooks for the specifically identified grades 8 and 11. At the junior and senior high school levels, there are often several grade levels in the same classroom, and in most schools only one teacher offers all of the art courses. In addition, the curriculum objectives within the junior high and senior high are quite similar. It was recommended, then, that there be "junior high" and "senior high" handbooks, which could more widely used by art teachers.

These recommendations were implemented in the development of Quality Indicators Handbooks for grades 2 and 5, junior high, and senior high school grades. Each handbook contained several teacher explanations of art lessons related to the curriculum at that grade level. With each lesson explanation is a set of colour reproductions of quality student art. Each reproduction is accompanied by "student intentions" and "expert observations" of the quality indicators that can be seen in the artwork. The format of the handbooks invites the users to become involved in the process of "*seeing with expert eyes*" and to model the same process in their own assessment practice.

Year 2: Field Testing

In the second year of EQI-Art, teachers and advisors developed and carried out a plan for the field testing of the EQI-Art handbooks in local classrooms. There were four stages to this year's work: **1) field testing the handbooks, 2) responses from the field-test teachers,** and **3) revising the handbooks prior to piloting**.

Field Test of the Quality Indicators Handbooks

Eight successful, professionally active teachers from the two Calgary boards were selected to field-test the Quality Indicators Handbooks in their classrooms during February and March 1991. These teachers were given a brief inservice and invited to use the handbooks in many different ways in their art teaching and assessment.

The EQI-Art field test was designed to encourage practitioners to use and examine the Quality Indicator Handbooks within the practice of their teaching situations in order to validate the research of the committees. The handbooks are intended to be used as a resource for the guidance of the practice of assessment in the learning environment.

The stated objectives of the field test were to:

- identify the strengths and weaknesses of the EQI-Art Quality Indicators Handbook (QIH) as a teacher resource;
- collect information from teachers who would be defined as "specialist" and "generalist" with regard to response to and use of QIH materials; and
- collect data about classroom conditions that contribute to the development of quality student art.

Field test teachers were involved in the following tasks:

- Field test teachers prepared a written assessment on a work of student art prior to the use of the QIH, then prepared a second assessment on another work at the end of field testing. These two assessments were analyzed by the EQI-Art advisors.

- The selected teachers field tested the initial version of a survey, "Teacher Survey of Assessment Attitudes and Skills," designed to answer questions about relationships between the characteristics of **experience, confidence, and expertise** in art assessment, and the **belief systems** of art teachers. Results are found in Appendix B.

- Field test teachers responded to the QIH materials by writing directly in the handbooks to suggest changes, additions, deletions to any parts, and by documenting classroom practice using the QIH.

- If teachers used the QIH materials in evaluative procedures, they were asked to share the manner or structures developed for this purpose.

- If teachers involved students in using the QIH materials — for example in self-assessment or peer assessment — they were asked to document the use in written accounts, audiotape or videotape.

Responses to the Field Test

At the end of the field test, information was collected on teacher attitudes and skills, uses made of the handbooks, and concerns teachers had in implementing the assessment practices. Responses from the field test teachers included perceived effects of the use of the QIH in the classes, recommended revisions to the handbooks, and suggestions for inservicing pilot teachers for next year.

A few of the field test teacher comments related to the use of the handbooks follow:

- *I found that when they [students] were doing their artwork — they were standing back and looking at how they could make changes and thinking about what they could do to improve their work.*

- *I referred to the pictures in the handbook and we discussed them in terms of quality indicators, and they [students] would do whatever it was that we were doing ... but they would really tune into the things that we had been discussing.*

- *I thought the intention [question] was excellent for the student ... I think it made the kids focus in, at least in junior high, on the objectives [of the lesson] and they were conscious of this throughout.*

- *I think probably technically they [students] would look for things more easily. They would really start to look at compositions and they would realize ... the influences they've had from other artists ... but maybe that's just because I'm prompting them more too. But I would say `yes' it's [EQI-Art] making a difference.*

The field test teachers were also involved in the process of looking at changes in their own assessment practice. Prior to beginning to work with the handbooks, each teacher was asked to write a critique of a student art work. At the end of the field test, teachers were again asked to write a critique, considering a different student piece. A comparison indicated an increase in specificity. In the earlier example, a teacher might write "*... a good use of colour*," but in the second example, write "*... blue adds definition to the figure and also gives the snowman a `cool' feeling.*"

Comments and recommendations provided by the field test teachers were used to clarify some of the instructions in the handbook, to add some insights to the art critiques included, and to reformat some of the materials for easier classroom use. The field test response of teachers and students to the EQI Quality Indicators Handbooks was enthusiastic. Improved practice was noted by the field test teachers themselves in a majority of cases.

Revisions to the Quality Indicators Handbooks Prior to Piloting

The initial handbooks used for field testing included a limited number of samples of student art, representing only two or three of the five art work categories identified by the EQI-Art project. Given the positive response to the style and contents of the handbooks, the project team decided to complete the presentation of all categories for the pilot year.

To obtain the art works necessary for this expansion, an invitation was sent to all art teachers in the two school districts to submit sets of student work for consideration. A significant collection of work was submitted for consideration. The EQI-Art teacher researchers and specialists who prepared the first edition of the handbooks prepared the pilot editions during the month of June 1991.

Initial handbooks contained only one grade level, or, as in junior and senior high, only one set of grades. Field test teachers requested that all grade levels be included in one handbook so that they could be used to illustrate a development of art practice and performance throughout the grades. The field test teachers suggested that the opportunity to look at the collection of work from all grades would benefit students as well as classroom teachers.

Consultants recommended that the project leadership reconsider the decision not to represent a variety of qualities, from below average to the truly outstanding. The consultants suggested that the handbooks would be more effective if they help generalist teachers to "recognize poorer performance along the various dimensions" (Maguire & Rogers, 1991). The expert teachers' experience, however, indicated that a repertoire of good examples of student work encouraged improved performance. Teachers and students in the pilot group appeared to learn more from the consideration of successful works rather than from the analysis of inferior or incomplete works. In addition, copyright laws do not permit the presentation of individual student work in a negative light. Consequently, the project leadership decided to stay with the original decision, to present only works which were of good quality for each grade level. Negative examples of student art work were not included.

However, at the beginning of every handbook, there would be a listing of the most obvious quality indicators — relationships, handling and meaning — with characteristics that can be observed. These outlined characteristics should assist a non-expert art teacher in identifying the dimensions of various qualities as well as in developing a vocabulary to use in providing art criticism.

Year 3: Pilot Testing

At the end of the second year, the EQI-Art project advisors revised the initial handbooks by increasing the number of art samples, and by including all grade levels in one volume. In order to increase the awareness of student thinking and to capture teacher reflections on art assessment, the art advisors incorporated reflective journals for both teachers and students into the pilot plans.

In the third year of EQI-Art, teachers pilot tested the handbooks in local classrooms. A variety of activities helped gather information about the value and usefulness of the handbooks. These two sections will describe the activities: 1) **pilot testing the handbooks,** and 2) **information gathering and analysis**.

Pilot Testing the Handbooks

From September 1991 until the end of January 1992, eight practicing art teachers from CBE and the CCBE participated as pilot teachers. As in the field test, the selected teachers were successful and professionally active, and participation was on a voluntary basis.

The objectives of pilot testing were to:

- identify changes in the assessment skills and attitudes of teachers using the EQI-Art Quality Indicators Handbook (QIH);
- identify changes in the assessment skills and attitudes of students using the EQI-Art QIH;
- collect information from teachers who would be described as "specialist" (teachers with a university degree in the field of art or art education) and "non-specialist" regarding their response to and use of QIH materials;
- collect information about pilot classroom conditions that support or hinder the development of quality student art;
- provide an indication of the changes in the quality of student art work that may be expected as a result of teacher and/or student use of the QIH; and
- identify the strengths and weaknesses of the EQI-Art QIH as a teacher resource.

Pilot teachers were familiarized with the background of the EQI-Art project and the development of the handbook during a day-long inservice session. Pilot teachers were asked to:

- use the handbook as a model to practice one or more assessment activities in their classes;
- have students use the handbook in classroom activities;
- use the model of the handbook to make one or more collections of their own, based on a classroom activity completed during the pilot period; and
- critique the handbook by writing in the book itself, by commenting in the reflective journals, and by reporting concerns to the project advisors.

Pilot teachers were provided with instruction and guidance about writing journal entries. They and their students were asked to maintain a journal of their reflections regarding the use of the handbook. The organizing questions for the journals were: "What did you learn from your use of the handbook today?" and "What questions occurred to you in your use of the EQI materials?"

During the pilot period, the art advisors visited all pilot sites to see how the work was going and to review the teacher and student journals.

Information Gathering and Analysis

Information gathering occurred prior to, during, and following the piloting experience. The information and analysis is reported here in four sections:

a. Identifying change in teacher attitudes and practice
b. Examining the use of teacher and student journals
c. Parent responses to the EQI-Art pilot and handbook
d. Pilot teacher "Conclusions" and "Recommendations"

a. Identifying change in teacher attitudes and practice

Pilot teachers completed a survey of attitudes and practice on two occasions — at the beginning of the pilot period, and at its conclusion. This survey was developed to identify changes in beliefs, attitudes, and practices relating to the use of QIH. The EQI-Art Pilot Teacher Survey is found in Appendix B. The survey provided demographic data about experience, background, and teaching assignment, as well as information regarding the beliefs and practices of teachers regarding art teaching, assessment, and student artmaking. The survey questions were also designed to collect information regarding Eisner's (1985) ideas of connoisseurship and criticism: "expertise," "confidence," and "use of subjective methodologies in art assessment."

Analysis: Demographic and descriptive data from the survey are reported in Appendix B. Analysis by SPSSX yields only a few statistically significant changes in teacher attitudes and practice between the two survey administrations, and these changes are not consistent in the direction of more or less confidence or expertise. The findings are not reported here because we feel the results are of limited use, given the small number of participants (11), the limited time (4 months) and the lack of reliability testing of the survey.

Pilot teachers also provided feedback to the art advisors both verbally and in written form at the final pilot meeting. Almost all pilot teachers commented that there were changes in their practice as a result of EQI. These changes included plans for using journal writing in future classes, awareness of changed viewpoints, needing to listen more to student intentions, and learning new ways to talk to parents about student progress in art. Some of their written comments follow.

- *[I] discovered how much students enjoy viewing other students' work. In fact, that is when it is easiest to gain and maintain class attention. They loved hearing the artist intentions.*
- *I credit art with being a higher level cognitive activity than before. As children wrote about their work they identified what must have been going through their minds subconsciously and brought it to a conscious level.*
- *I found that because of my involvement with EQI my way of teaching has changed — it has also carried over to other subject areas as I have discussed and worked with my class on ways to produce "quality" work. They and I both look at what they are doing differently — what makes this quality work? what are they happy with, and why? what might they like to work more on? and what was difficult for them?*

b. Examining the use of teacher and student reflective journals

Pilot teachers were provided with journals for their own use and for the use of their students at the start of the pilot period. During the course of the pilot, art specialists from the two school systems visited all of the pilot classrooms, taking time to review teacher and student journals and to write in them when appropriate. At the completion of the pilot period, teachers brought these journals back to the project advisors for analysis. Most of the pilot teachers commented positively on the use of journals, both for themselves and for their students. Most teachers identified a connection between student writing and thought processes that enhanced the quality of student work.

Analysis: Two experienced art teachers currently enrolled in graduate art education programs at the University of Calgary were engaged to carry out an analysis of the journals used in the EQI-Art pilot. These teachers had experience in journal analysis, and had some familiarity with the EQI project. Their conclusions follow. The complete report is found in Appendix B.

In conclusion, we saw the journals as holding the possibility for being an excellent means to foster artistic learning. The opportunity for teachers to reflect on their own practices was described by many *as being "invaluable." Their constant questioning and striving to understand the project was made clearer through their reflections, observations and feelings about their art classes and students. We saw the place of the teacher as pivotal in regards to facilitating the use of the journals in an approach that promoted a continuing and evolving discourse. The students' journals fostered reflection on their art learning, and developed a heightened sensitivity to elements within a whole. It is hoped, therefore, that this encouraged quality improvement in student art work.*

c. Parent responses to the EQI-Art pilot and handbook

Parents with students in the pilot classes were contacted and invited to discuss the project experienced by their children. Meetings were held in the pilot schools with small parent groups.

Analysis: Written and oral responses from parents were positive towards the project as they understood it, and they expressed appreciation for being invited to respond. Sample comments follow.

- *I think the art handbook is a great idea. It helps to give the children an idea of what is expected on certain projects. It also helps to set out guidelines so the teacher knows what to look for. I think it will help the children to take pride in their art work and put more time and effort into their projects.*
- *Good concept. Shows children what is expected. The written paragraph gives a child a chance to express their idea or intention.*

d. Pilot teacher conclusions and recommendations

During the final meeting of the pilot teachers, we asked the teachers to respond in writing to the headings listed above. We collected these responses and recorded discussion regarding the pilot experience.

The conclusions reached by the pilot teachers often referred to the value of "talk," "language" and "vocabulary" as important aspects of focusing student attention on the art problem, getting students to articulate their knowledge about art, and sharing understandings of quality in art. Another main theme was the opportunity to see and hear what colleagues had to say about art assessment. Many teachers wanted an extension of the pilot meetings, and expanded versions of the EQI handbook.

- *I think the most positive aspect of the project was having the students write down their thoughts and intentions about their work. It focused their ideas, concerns and observations about their work.*

- *[The EQI-Art Handbook] provides concrete examples of how to talk about specific pieces of art. Teachers may be familiar with terms such as pattern, unity, etc., but not know how to use these in discussion. By simply reading what other teachers have written about children's art makes it easier to incorporate these ideas into classroom practice.*

The teachers had many recommendations for future developments, for inservice, for other ways to use the book in classes, and for using journals as an integral part of assessment. Some comments follow.

- *Inservice of some form is essential to use the book as a resource.*

- *It is really important that teachers and students have the time and opportunity to reflect on their work. The use of journals is an important aspect of this. It is just as important that teachers and students be given the opportunity to dialogue with each other and their peers — EQI certainly heightens one's awareness of the possibilities of art education and how to more accurately and fairly assess student work.*

Follow-up activities suggested for teachers, for schools, for school system art specialists, and for Alberta Education included: that handbooks be made readily available, that time and support be given to teacher meetings about assessment, and that the EQI project people have a big celebration to commemorate our work together.

Pilot teachers were asked to critique the handbook and to bring editorial and structural suggestions to the final pilot meeting. A thorough review of the entire handbook was held during the meeting and all comments and suggestions were considered. The EQI-Art advisors revised and edited the entire handbook during February and March 1992. The desired changes included: an expanded introduction to the handbook; suggestions for the use of the handbook in classrooms; suggestions for provoking discussion regarding quality in art; and practices that stimulate journal use. Revised handbooks were provided to all teachers and advisors who worked on the project, to teacher resource departments in the two school boards, to university personnel for use in teacher preparation, and to Alberta Education.

Findings and Conclusions (Outcomes)

The EQI-Art researchers, both teachers and specialists, understood from the outset that the project required a lengthy period of development and trial and error. This indeed proved to be true, as we tried and discarded many different approaches during the initial year and a half. Our committee process was to question, to research, to intuit, to test, and to revise our materials and our ideas about assessing quality art. The final handbook represents the wisdom we collectively shared regarding the assessment of quality in student art.

The art advisors considered information collected from all sources and in many forms in preparing the following conclusions about the EQI-Art project:

- Quality assessment practice supports improved art making.
- Written and/or spoken student responses, reflections and thoughts illuminate the art work.
- Quality art assessment is a shared experience between teachers and students.
- Common vocabulary shared by teachers and students affects assessment.
- Collection of quality art exemplars emphasizes diversity as an attribute of a quality art program.
- Informed professional judgement benefits from collegial work.
- Assessment takes time: time for students to prepare a quality outcome and for teachers to thoughtfully reflect and respond.
- EQI handbook exemplars provide a way to share expertise and vocabulary, and to develop connoisseurship.

CHAPTER 4: EQI-MATH

Introduction to EQI-Math

The most important goal of mathematics instruction in Alberta is the development of students' abilities to solve problems. The General Learner Expectation for mathematics is that: students are confident and increasingly competent in solving problems as they develop and demonstrate understanding of mathematical concepts, relationships and procedures (Alberta Education, 1992, p. 3).

Problem-solving abilities and attitudes are also at the core of descriptions of numeracy, or mathematical literacy. The lack of mathematical literacy has been identified as an economic liability for a nation, a personal limitation, and a source of systematic discrimination for women and minorities (National Research Council, 1989; National Council of Teachers of Mathematics, 1989).

One of the prime documents recommending change, *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989), describes standards for mathematics literacy in the 1990s and provides guidelines for the revision of curricula and assessment toward this literacy. There are five goals for students:

1) learning to value mathematics
2) becoming confident in one's own ability to do mathematics
3) becoming a mathematical problem solver
4) learning to communicate mathematically
5) learning to reason mathematically

These considerations clearly extend the expectation of mathematics instruction from the acquisition of specific skills and processes through to positive attitudes toward and the use of mathematical reasoning in many different life situations. This expansion of expectations regarding problem-solving skills and dispositions to problem solving has been accompanied by some change in teaching and testing methods in schools, and intense interest in developing new methods in response to the need for change.

The EQI-Math Project involved practicing mathematics teachers and mathematics subject specialists in a search for new methods to assess student achievements in problem solving. Table 2 on the following page outlines the activities of the EQI-Math project from 1989 to 1992. Appendix C contains a sample of the project materials.

Table 2: EQI-Math Project Outline

	Phase 1: 1989-1990 **DEVELOPMENT**	**Phase 2: 1990-1991** **FIELD TESTING**	**Phase 3: 1991-1992** **PILOT TESTING**
Personnel	school system mathematics specialists (5) teacher researchers (14)	school system mathematics specialists (5) teacher researchers (14)	school system mathematics specialists (5) pilot teachers (8)
Tasks	problem-solving dispositions identified through anecdotal records of problem solvers problem bank developed problem format and student attitude questions chosen holistic scoring studied	10 problem-solving dispositions tracked open-ended anecdotal records kept 8 problems administered: choice of time for response and group work 2 scorings for each problem student attitude responses collected — different for all grades classroom environment described by teachers	5 problem-solving dispositions tracked structured anecdotal records kept 6 problems administered: choice of time for response and group work 2 scorings for each problem student attitude responses collected — same for all grades classroom environment described by specialists
Results	10 dispositions for all grades: confidence, perseverance, risk-taking, understanding, achievement orientation, motivation, communication, creativity, organization and reflection holistic scoring: "A" inadequate "B" adequate "C" competent	10 dispositions too unwieldy: analysis helped develop 5: • motivated • creative • confident • strategic approach • strategic process problems reworded problem formats reviewed: rewording/removal of grids for answer formats new holistic scoring developed: • preliminary • partial • complete • elegant	disposition gave important, useful information problem scoring positive, effective, quite consistent anecdotal records still problematic student attitude responses not useful environmental scan questioned

Year 1: Development

Quality indicators are observable characteristics of excellence established through consensus of professional judgement among practising teachers. Problem solving is the application of known mathematical knowledge to an unfamiliar situation so as to arrive at a solution (EQI Project definition).

The expectations and objectives of mathematics programs direct attention to students applying math skills and processes and approaching the use of mathematics with self-confidence, a positive attitude about the efficacy of math in understanding real life situations, and enthusiasm. The indicators of problem solving therefore apply to these aspects of student outcomes as teachers observe them in classrooms.

During the first year of the EQI-Math project, teachers and advisors examined many aspects of mathematical problem solving, developed sample problems and prepared materials for use in recording observations about student problem solving. The four main areas of activity for Year 1 are presented in the following sections: **1) identifying student dispositions; 2) specifying problems for use with students; 3) developing holistic marking; and 4) documenting student understanding.**

Identifying Student Dispositions

We began our quest for quality indicators of mathematical problem solving with a team of 14 successful, professionally involved mathematics teachers (EQI-Math teacher researchers) and 5 mathematics subject area specialists (EQI-Math Advisory Committee) from the Calgary Board of Education and the Calgary Catholic Board of Education. Personnel involved are listed in Appendix A.

The selected teachers and advisors began their work by exploring the concept of quality in mathematical problem solving. It was apparent that experienced mathematics teachers identify successful problem solvers by their dispositions or personal characteristics, in addition to their possession of particular math skills and success in solving math problems. Initial meetings of the EQI-Math committees centred around discussions of what defined good problem solving, and how to identify good student problem solvers. The identification of good problem solvers led to the development of a list of characteristics or traits that described student "dispositions" (The National Council for Teachers of Mathematics):

> Disposition refers not simply to attitudes but to a tendency to think and act in positive ways. Students' mathematical dispositions are manifested in the ways they approach tasks —

> whether with confidence, willingness to explore alternatives, perseverance, and interest — and in their tendency to reflect on their own thinking (NCTM, 1989, p. 233).

Initially, teacher researchers recorded observations of strong and weak problem solvers in their classes to obtain descriptive comments about problem-solving dispositions. These records were in the form of informal "anecdotal records." Teachers found this task to be difficult because there was so much that could be observed, and decisions about what to include or not include in the anecdotes were complex. The teacher researchers shared their experiences with one another and discussed anecdotal records for the students in their classrooms. As a result of these activities, ten dispositions were identified, and descriptions of each disposition were developed from teacher observations.

The initial lists of dispositions prepared by teacher researchers at both elementary and secondary grades were very similar, so it was decided to proceed with one list of dispositions for students at all grade levels. The teacher researchers agreed that although not all of the dispositions would be displayed by any one individual student, a student who was a good problem solver would display at least several of them. Appendix C contains the original ten problem-solving dispositions and descriptions. Seven of the ten dispositions described are similar to those outlined in *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989, p. 233).

Specifying Problems for Use with Students

The dispositions towards problem solving are developed over time as students experience classroom mathematics activities. An important part of activities to identify quality indicators is the context for students to display their dispositions and their problem-solving skills. Student problem-solving dispositions were observed in the classroom context where students were engaged individually and in small groups with mathematics problems.

Teacher researchers began by selecting student mathematics problems to conform to the curricular demands of each grade studied (grades 2, 5, 8, and 10) at the time of the school year the problems were to be administered. Problems were identified for each strand of the curriculum and for non-routine, challenging situations. Teachers used personal knowledge, resources available in the two school systems, and published sources for problem ideas.

Attention was paid to presenting a variety of problems from the mathematics curriculum strands, and to encouraging substantial student responses. No attempt was made to control the nature of the problems at each grade level, and teachers prepared a large "bank" of problems from which to choose.

The teacher researchers considered the format of the problem statement and the student response sheet to be important elements. A format was selected for each grade level, including a prompt for students to show all their work, a response structure (especially for grades 5 and 8) and some statement of affect from the student (How did you feel ... ?). Samples of these problems are found in Appendix C.

Developing Holistic Marking Criteria

The EQI teacher researchers began the exploration of scoring problems by reviewing problem solutions provided anonymously by other teachers. These solutions were used in several ways: to identify quality in student responses; to develop some common expectations for student problem responses; and to gain an appreciation of the variety of problem-solving responses and interpretations there could be.

The teacher researchers used marking practices that varied from holistic or impressionistic, related to the overall nature of student performance, to analytic or rubric-based, including specific predefined requirements that reflect the expert opinion regarding the important elements of a problem. The teachers reviewed a wide variety of systems used in holistic marking prior to developing some formats for scoring the problems used in the EQI-Math project. An holistic structure, representing each problem solution as either "A" inadequate, "B" adequate, or "C" competent were the categories used during the first year.

Documenting Student Understanding

Teacher researchers continually considered the problem of understanding the thoughts of students that were not expressed in their written solutions. They attempted to improve the fullness of student responses in various ways: by preparing a structured response form for students in grades 5 and 8; by using the encouragement "Please Show and Explain All Your Work" on every response sheet; and by providing lots of paper for the student response. Teachers also considered the use of journal entries or learning log entries to clarify student thinking.

The project activities in the first year considered: the presence in students of positive dispositions towards problem solving; the quality of math problems; marking approaches for the written responses; and discovering more about the thinking of students. The activities of the second year built on this work.

Year 2: Field Testing

The project activities in the second year addressed five factors that appeared to contribute to quality problem solving in mathematics: **1) student problem-solving dispositions; 2) selection and presentation of problems; 3) holistic scoring scales; 4) student attitudes; and 5) conditions of mathematics learning in the classroom.** EQI-Math teachers and advisors prepared and field-tested materials and practices as they worked together to extend their knowledge about each of these five factors.

Student Problem-solving Dispositions

Teacher researchers documented classroom observations of the 10 student dispositions on several occasions. Students were observed in mathematics classes (not only during the completion of the EQI assigned problems) and a record was to be made of whether the disposition was "present" (+), "not present" (-), or "not observed" (0). A sample Disposition Checklist is found in Appendix C.

The teacher researchers found that using the disposition checklists was a difficult activity. First, many teachers found the number of observations to be made cumbersome.

- *I really have found the inventory sheets and disposition sheets for the whole class time consuming and difficult to do so early in the school year. One problem may show only one or two of the dispositions given. So it seemed to take a lot of problems in order to assess all dispositions.*

- *[There are] too many dispositions to track for each student.*

Second, many teachers were personally uncomfortable with the process of using the checklist and the inferences that were made from the observed behaviours.

- *I was overwhelmed and frustrated trying to complete the dispositions —I like to be accurate and somehow see this [impression] as being written in stone.*

- *Some of the dispositions — I felt I was guessing on and would have difficulty giving valid reasons why I had given the child a "+" or a "-."*

- *I feel the disposition sheets are not valid at this point. I'm just beginning to know my students and it is only now that I feel comfortable making comments on the students.*

However, teachers did find that the exercise of completing the disposition sheets allowed them to discover interesting and valuable information about individual students.

- *I'm finding it difficult to be objective. However, I do find that knowledge about the children, how they approach tasks, what kind of a communicator they are, is important.*

During the second year, the teachers were also provided with "Anecdotal Record" sheets to record observed behaviours for each of the 10 dispositions for two students. Each teacher was asked to record observations of one "good problem-solving" student, and one "weak problem-solving" student. An example of one of these records, Inventory of Mathematical Disposition Experiences for .... appears in Appendix C. This was a challenging task, but all teacher researchers completed at least two of these records for students in their classes. These records were collected into grade group descriptions, and summarized for students at each of the grades.

The anecdotal record activities proved to be very illuminating for the teacher researchers and also for the project advisors. There was a variety of interpretations of the dispositions, and variation in the clarity of description provided by the teachers. Some teachers prepared lengthy descriptions of student behaviours — *"Her communication about doing math problems is at a functional level. For example, first you do this and then this. She doesn't seem to look for concepts."* and other teachers recorded very brief comments, such as *"Student communicates well."*

Because identifying student dispositions and recording descriptions presented a number of difficulties for the teacher researchers, some revisions to the materials and procedures were made. Three approaches to reformulating the identification of dispositions were pursued:

a. **Consolidating the dispositions to be identified.** Factor analysis using a principal components method with iterations was carried out on the checklist data prepared by the teacher researchers during the second year of the project. One significant factor was obtained which was highly related to other factors. For the pilot year, in order to conceptualize this factor, dispositions were reduced to five and descriptions altered and refined. The five dispositions and their descriptions, "Mathematical Dispositions," are in Appendix C.

b. **Reducing the number of observations required of teachers.** Pilot teachers were asked to record observations of the five problem-solving dispositions twice during the pilot period — early in September and at the beginning of December, toward the end of the pilot.

c. **Restructuring anecdotal record forms and procedures**. Pilot teachers were given inservice with a highly structured format prior to the pilot. Three records were made during each problem assignment.

Selection and Presentation of Problems

The teacher researchers selected eight problems to field test with their math classes. The student responses were rated by the teacher, then by one other teacher at the same grade level. Teachers at each grade level met several times during the field test to discuss concerns and new learnings.

Field testing the problems provided information to teacher researchers on the following issues:

a. **Wording of problems**. The teacher researchers discovered that several problems were misunderstood by students partially as a result of the words used. Problems were reworded by the advisors.

b. **Answer formats**. Advance organizers, in the form of "boxes" for parts of the problem-solving process for students at grades 5 and 8 received mixed reviews from EQI-Math teacher researchers and advisors. Several teachers found the boxes very helpful in organizing and encouraging the work of their students, while others observed that the boxes inhibited student responses. The advisors decided to remove the boxes from the problem solution sheets used in the pilot. Problems for piloting are printed on 11" by 17" sheets, folded to a 8.5" by 11" format. The problem sheets provide about three regular sized sheets of space for the student solution.

c. **Time allowed for completion of problems**. During the field testing of problems, teachers decided on the appropriate time limits in their own classes. Although the time allowed varied among classes, this practice did not seem to pose any problems for the project and was continued in piloting.

d. **Individual or group administration**. Teacher researchers selected a method of problem presentation that suited their classes and teaching styles. Some encouraged students to confer with partners or in small groups and some required the students to work strictly by themselves. All students prepared a response sheet for each problem. Although there was some discussion regarding the "fairness" of using collaborative processes, the advisors decided not to restrict how a teacher presented the problem. The pilot teachers were asked to record if collaboration was allowed with each problem. Teachers were reminded that the EQI-Math project materials were not designed to compare individual achievement for evaluative purposes, and therefore did not require the strict control of conditions.

Consultants working on the provincial EQI project encouraged the EQI-Math advisors to review and revise problems as necessary, with a view to producing a set of guidelines for the construction of "good" problems. Rather than keeping EQI-Math problems confidential, consultants encouraged the development of many problems and the preparation of problem construction guidelines. It was also determined that six problems would be sufficient to provide qualitative samples during piloting.

Holistic Scoring Scales

The teacher researchers field-tested eight problems at each grade level. They were asked to write out their holistic scoring criteria, then score each problem solution either "A" inadequate, "B" adequate, or "C" competent. This letter rating was marked on the back of the student response. A second teacher re-scored the paper, using the same three letter markings. In some cases, a third marker was used to provide an additional rating of the student response. Teachers did not discuss their interpretations of the holistic criteria at length prior to the scoring exercises.

After the scoring process was completed, teachers were asked to explicitly define their interpretations of the holistic scoring criteria. These were collected and then summarized.

Consultants with the provincial EQI project reviewed the holistic scoring processes and criteria, and recommended that the project consider structuring categories that reflected levels of elaborated thought — from very minimal or simple, to highly elaborated, abstract conceptions. EQI-Math advisors were encouraged to provide more than three categories of holistic ratings — perhaps by adding a rating of "elegant," or by adopting a five point scale.

Subsequently, the EQI-Math advisors prepared a new holistic scale. The characteristic that discriminates between the first three levels of scoring is the degree of progress made toward a solution, from partial to complete. The fourth level, "elegant," is self-explanatory. Advisors also changed the depiction of the holistic categories from *scoring criteria* to *response criteria*. A copy of the Holistic Response Criteria is found in Appendix C.

Student Attitudes

In order to understand better how students respond to problem solving, the teacher researchers decided to include a measure of student attitudes with each of the EQI problems. The attitude question was placed at the bottom of each answer sheet. During the field testing, each grade level used a different attitude response format.

The grade 2 format included three faces: "happy," "neutral," and "unhappy." Data analysis indicated that student attitude related to problem ratings when the problem was difficult. However, it was interesting to note that a student who received a rating of "A" (inadequate) on a problem that is easy or of mid-range difficulty was just as likely to be "happy" as a student who received a rating of "C" (competent). Put in another way, a student who received a rating of competent is just as likely to be "unhappy" as a student who received a rating of inadequate.

Grade 5 students were provided with the prompt: "How I feel about this problem? Explain." with lines provided for the response. Grade 8 students were asked: "Circle words that tell how you feel about this problem or write your own words. Easy _____ Challenging _____ Confusing ______ Fun _____ or ______." At the Grade 10 level, students were asked to: "Circle words that tell how you feel about this problem or write your own words. Boring _____ Challenging _____ Confusing ______ Fun _____ or ______."

Asking students about their feelings towards a problem was thought to help teachers prepare more interesting or appealing problems. Another dimension of student attitude is the feeling a student has after completing a problem. To obtain this information, advisors decided to ask students to respond to a statement that refers to how they feel after attempting to solve the problem.

The EQI-Math pilot problems included two statements:

The word I would use to describe this problem is:

Boring ______ *Challenging* _____ *Confusing* _____ *Fun* _____

After trying to solve this problem I feel:

Discouraged _____ *Satisfied* _____ *Frustrated* ____ *Happy* ____

Conditions of Mathematics Learning in the Classroom

Teacher researchers were asked to assist in describing their classroom mathematics environment by responding to the statement: "Describe what is happening in your math classroom." This description was to be made at the time of presentation of each EQI problem. Each teacher researcher provided eight descriptions of the classroom environment. No specific format was prescribed for the responses, although teachers were encouraged to talk about such elements as the curriculum emphasis, style of teaching, and unique classroom features they thought might influence the problem-solving results.

Some of the teachers used the response to describe lesson topics:

- *Geometry has been the main focus - symmetry, constructing 3-D shapes, 2-D shapes.*

- *Free explorations of manipulatives. Group problem solving every day. Group graphing (i.e. birthdays). Pattern problems (Guess my rule: shoes with laces or without laces).*

Other teachers described student organization:

- *We have formal group instruction in math in the morning (with or without manipulatives, depending on the developmental level of the children). In the afternoon we have learning centres in which the children practice and extend their skill development. The children sit in groups of five. We have some group solving of problems as well as individual. We will also be working in pairs, but have done little of this yet.*

Still other teachers focused on student responses to the mathematics instruction:

- *Students are beginning to enjoy problem solving. They begin problems in groups and understand never to leave a piece of paper blank. Some are becoming real risk-takers, while a few want to always play it safe and find the "correct" answer.*

- *Students are becoming better able to cooperate and work in small groups as the school term continues.*

Teacher researcher responses varied in comprehensiveness, style, and detail. There was little in common among the responses to characterize classroom styles.

A very interesting finding for the EQI-Math advisors was the indication that for some of the teacher researchers, problem solving is still a "Friday event" rather than an integral part of the daily mathematics instruction.

Teacher researchers were asked to respond to the statement: "How did you present this problem to your students?" Again, no specific framework was given for the responses and again, both the quality and the nature of the records varied considerably. This information identified whether or not students collaborated with one or more classmates while working on the EQI problems and provided additional background about the classroom environment.

After working with the EQI-Math project for two years, the teacher researchers were asked to respond to a set of questions regarding their experiences in working with the project and how the project affected their teaching practice in the area of mathematical problem solving.

The teacher researchers were unanimously positive about the experience in working with the project, most often citing *the opportunity to work with colleagues, the learning about students, and the exposure to new ideas*. Their concerns with the disposition ratings, anecdotal records, holistic scoring, and problem solution formats were used to edit the problems and amend procedures for the pilot. The need for time to meet more often and for inservicing was a primary concern in their recommendations.

When asked about the impact on their teaching and student problem solving, all reported some positive effects of EQI. Some of their comments follow.

- *I have begun to experiment with the introduction of problems before the required skills have been taught. Hopefully, this will give more meaning to the mathematical concept!*

- *I'm integrating problem solving into many math tasks, not just treating it as a strand. It's incorporated into other subjects. My observation skills are improving.*

- *[Students have] increased confidence. I had students score some of their own work holistically, and now they are more self-aware.*

- *I believe my students are more confident about problem solving and have become greater "risk-takers." They are very willing to try to solve problems and use more strategies than they did in September.*

Year 3: Pilot Testing

The project activities in the third year centred around the pilot testing of materials in local classrooms and the gathering of results from that pilot test. This section reviews the following activities of the third year: **1) pilot testing activities; 2) analysis of pilot testing data; 3) development of "Problem Solving Profiles" handbook; and 4) findings and conclusions.**

Pilot Test Activities

The EQI-Math materials were piloted in eight Calgary Board of Education and Calgary Catholic Board of Education classrooms from September to December 1991. Pilot teachers were identified by the system mathematics specialists as being successful, professionally involved teachers of mathematics. If school principals gave their consent, prospective pilot teachers were asked if they wished to volunteer. The pilot teachers had no previous involvement with the EQI-Math project.

Selected pilot teachers attended two days of inservice for which they were given release time from their teaching duties. The EQI-Math advisors and a professor from the University of Calgary provided sessions covering all the aspects of the pilot process, from the philosophy of problem solving to filling out the necessary project forms. This section includes: a) problem-solving dispositions, b) preparing anecdotal records, c) presenting the problems, d) problem rating, e) documenting classroom conditions, and f) providing feedback about the effects of piloting.

a. Problem-solving dispositions

Pilot teachers observed their students at the start of the pilot, and recorded whether or not each of the five dispositions was "displayed" or "not displayed" or "not observed." The five dispositions are:

- motivated
- creative
- confident
- strategic approach
- strategic process

Pilot teachers recorded a second observation of student dispositions during the administration of the fifth problem in the pilot set. Record sheets provided to teachers did not contain the information about the first teacher observation.

b. Preparing anecdotal records

The pilot teachers practiced preparing anecdotal records during the inservice by viewing a videotape of student problem solving and recording observations. Three students were observed during each of the problem assignments and records made on structured anecdotal records forms. Teachers were asked to select one student they thought to be a good problem solver, one who is a weak problem solver, and an "I'm-not-sure-about-problem solver." A sample anecdotal record appears in Appendix C.

c. Presenting the problems

Pilot teachers administered six problems to the selected pilot classes during the same weeks. Teachers could allow students to collaborate with their peers at the beginning of the problem session, but all students were required to submit a solution for rating, noting whether they collaborated with others on their solution sheet. The time allowed for each problem was determined by the teacher.

Four graduate education students interviewed two students at each problem administration. The students were coached in "flexible interviewing techniques" and consulted with Dr. O. Chapman, a mathematics professor, as necessary. Both video and audiotapes were taken of each problem-solving session, and the audiotapes were transcribed. Excerpts from the transcripts are included in the "Problem Solving Profiles" to illuminate processes of student thinking that are not included in written responses.

d. Problem rating

The Holistic Response Criteria were examined and discussed at the pilot teacher inservice. Pilot teachers were encouraged to sort the student responses to the EQI problems into three groups: "Preliminary," "Partial" and "Complete." Following that, they were to review the "Complete" set, and select any responses that were "Elegant."

Teachers rated their students' responses using the holistic response criteria, and recorded this rating on a form sent in to the project office. The problem responses were then sent to the colleague pilot teacher at the same grade level for a second rating. This pilot teacher then sent the second score and the student solutions to the project office.

e. Documenting classroom conditions

The pilot teachers responded to questions about their teaching practices and beliefs at the beginning of the pilot process and at its completion. These responses formed the basis of our analysis of changes in teacher attitudes and behaviours as a result of using the EQI-Math materials. A copy of this survey form, "EQI-Math Problem-Solving Practices and Beliefs" is included in Appendix C.

EQI-Math advisors visited each pilot classroom and completed an "Environmental Scan." The scan attempted to describe the classroom environment through a series of responses to questions about the classroom organization, teacher practice, materials available, and other resources.

f. Providing feedback about the effects of piloting

At the final pilot teacher meeting in January 1992, the pilot teachers provided both written and oral responses to questions of interest regarding the results of the project. All of the responses were maintained and provide a rich source of qualitative data for the preparation of project reports.

Analysis of Pilot Test Data

a. Problem-solving dispositions

Disposition records for the first and second observations were compared. Data analysis showed that in the second observation, one or more dispositions were observed in 64% of students, an increase of 16% over the first observation. The most substantial change was reported in the strategic process disposition. For all grade levels, correlation coefficients between dispositions and problem ratings as measured by Cramer's V were low to moderate, ranging from .06 to .38.

b. Preparing anecdotal records

The anecdotal records developed by the pilot teachers were reviewed by Olive Chapman, mathematics professor at the University of Calgary. The records have been used to develop materials regarding observation and flexible interviewing for classroom teacher use.

In reviewing the anecdotal records kept by teachers, it was apparent that teachers used a variety of approaches, were not uniformly prepared to do the task of documentation, and found the processes of drawing inferences and teaching recommendations very challenging. Some of these factors might have been eliminated if more time had been spent inservicing and preparing teachers to observe and record student behaviour, and to make inferences and teaching recommendations as a result.

c. Student problem ratings, attitudes, and dispositions

The EQI-Math project was designed as action research, and no research questions or proposals were established prior to the implementation of the project. However, some data were collected in the process of completing the project activities and these data were available for whatever information they might yield.

d. Documenting classroom conditions

Prior to the pilot, the selected teachers were asked to respond in writing to a set of questions regarding their beliefs and practices. At the conclusion of piloting, teachers were asked to respond again to the same set of questions. The two sets of responses were analyzed to permit identification of changes in individual teacher's comments over time.

The EQI-Math Advisory Committee reviewed the responses and identified changes in teacher beliefs and practices. Responses to questions about problem-solving beliefs did not seem to change significantly between the two surveys. Teachers selected for piloting were already strong teachers, with firmly held beliefs about learning and teaching. However, the pilot teachers did report some changes in their practices and some plans for change in the future. Some of their comments follow.

- *The project has made me do more problem-solving lessons. It also helped me track students differently. It gave me more definite ways to categorize what I saw.*

- *[I will] be more conscious of the process rather than the end product. Give students plenty of problems at the beginning of the year and not mark them ... no risk involved.*

- *I now mark holistically because it gives a clearer picture of the strategies students are using, and I also have a better idea about which students would benefit from interviews.*

e. Providing feedback about the effects of piloting

Math pilot teachers responded in writing to the question: "Are your students better problem solvers as a result of your participation in the EQI-Math pilot?"

Students were seen to be better problem solvers to some degree in every pilot classroom. Pilot teachers provided many comments suggesting that improvements occurred as a result of risk-taking, working in groups, encouragement to try different ways, increased discussion, and generally, a more positive attitude. Some of their comments follow.

- *The encouragement of multiple solutions and creative responses allows children to be individuals, and respect their choices.*

- *[There is a] strong component of talk and the need to explain, clarify, work through ... such that students developed confidence to use their "voice."*

- *I believe they are better now because I'm looking at them through a new pair of eyes — this project has shown me a few new things about how students attack problems. Thus I can now better address the problems they may have and I think I can better appreciate why some are having difficulties ... hopefully, this will help us all to become better problem solvers!*

The pilot teachers also discussed their responses to the various aspects of the EQI-Math pilot — the holistic scoring, disposition identification, anecdotal records, student attitude reports, and conditions that encourage quality problem solving. The summary notes from these discussions were prepared by the math advisors.

Holistic scoring was well received by all teachers although secondary teachers were concerned with becoming more precise and expanding the descriptors. In general, the focus on the process over product, the lack of a discouraging "mark," and the sharing of expectations about a good solution were seen as very positive features.

Disposition identification was positively received by most of the teachers because it "focused the observations" and provided a tool and vocabulary for reporting. At the junior high school level, there was concern that trying to make a judgement about dispositions from observation was sheer guesswork, and there was great variety in students from one problem to the next.

Anecdotal records were criticized by all pilot teachers as being "frustrating," "time consuming," "inaccurate," or "interfering with the teaching process." A few positive comments related to the possible use in student interviews.

Student attitude reports were criticized by pilot teachers at all grade levels. In the early grades, teachers felt that the students didn't really understand the words. In the senior grades, there was concern about the vocabulary used, and whether students took the response seriously. A few students at each grade level were seen to give the response a lot of thought.

Conditions that encourage quality problem solving were similar for all grade levels. Teachers identified time, the opportunity to work in small groups, the free discussion of ideas without judgement, a facilitating teacher, resources in the classroom, and good problems as important conditions.

The EQI-Math teacher researchers and pilot teachers provided a large amount of qualitative information about their experiences and observations throughout their work with the project. This information was reviewed by an evaluation specialist who prepared a summary questionnaire based on the information in the qualitative responses. This questionnaire and the results are included in Appendix C.

Nineteen (79%) of the 24 teachers who had been involved with the project responded to the survey. All of the respondents agreed that their *participation in EQI has been a valuable learning experience*, and 95% agreed that *involvement in EQI has made them a better teacher of mathematics*. Teachers at all grades who participated in the EQI project experienced the greatest increase in skill and confidence in the area of *assessment of student growth in problem solving*.

During the piloting of EQI-Math materials, the mathematics advisory committee visited all pilot classrooms at least once, and prepared an "environmental scan" regarding the classroom conditions.

Math advisors expressed discomfort with using one or two limited observations as indicative of a classroom environment, so this information is not used in the project findings.

The two pilot teachers at the grade 5 level asked students to respond in writing to their experiences during piloting. Students were given some class time and encouraged to contribute their ideas.

The students reported that they learned about approaches to problems as well as interpersonal relationships in doing the EQI problems. The student responses all had positive elements. Here is one sample:

- *I really liked doing the problem solving. It was very interesting. I think it was a good idea to work in groups because if you didn't understand the problem, the group could help you. I learned that sometimes I chose the wrong strategies and I learned that I should check the problem. Sometimes my group did not make a plan and we got the problem wrong.*

Development of "Problem Solving Profiles" Handbook

The teacher researchers and the pilot teachers reported that discussing student responses with other teachers was an important benefit of participation in this project. Recognizing the value of this sharing of ideas, the EQI-Math advisors began in 1991 to plan the development of a "Problem Solving Profiles" book that would provide teachers with approaches to problem-solving assessment from the EQI project.

The profiles contain information about student dispositions, holistic scoring, and flexible interviewing. For each grade level, a selection of student solutions illustrate samples of student work that show the characteristics of the holistic response criteria. Student solutions were selected from the pilot project. Each solution is accompanied by observations of expert math teachers who have been involved with the EQI-Math project.

The "Problem Solving Profiles" handbook contains the elements described above. The handbook presents classroom assessment of three elements: *1) what students do when solving problems; 2) how students think when solving problems; and 3) what students write down in response to problems*. "What students do" can be observed and recorded in anecdotal records and linked to the student dispositions. "How students think" can be approached through the use of flexible interviewing techniques. "What students write" is shown in their problem solutions and can be scored holistically. The handbook provides a small amount of theory and practical examples that model assessment of each element of student problem-solving behaviours.

Findings and Conclusions

The Calgary EQI-Math Project identified indicators of quality student work in problem solving in mathematics, grades 2 to 10. Indicators can inform the educational practice of teachers and students in several ways.

- Teachers can use EQI-Math materials to: plan and implement instructional strategies and programs appropriate to student needs; maintain accurate, informative documentation regarding the educational attainments of students; and report back to students, parents, administrators and others about these attainments.

- Students can compare their efforts with models or exemplars of quality work, develop goals and personal standards to attain, and apply their energy to improving their learning.

After the development and testing of classroom materials designed to develop indicators of student problem solving, project advisors reported the following conclusions.

- Teachers reported positive changes to their teaching and assessment practices as a result of participating in EQI-Math.

- Teachers wanted to meet to discuss teaching and assessment. The experience of working closely with colleagues was very positively received.

- Some of the materials and practices developed in the project were seen to be useful. Specifically:

    - student dispositions were helpful in observing students, and in developing understandings about student thinking

    - holistic scoring was helpful in two ways: teachers looked beyond the answer to the processes used by students; and observation and reflection were encouraged

    - looking at many student solutions helped both teachers and students understand and communicate about the diversity of responses and what quality problem solutions look like

- Some of the materials and practices developed in the project were not seen to be useful. Specifically:

    - anecdotal records were very time consuming and inconsistent for use in large-scale problem-solving assessments

    - student attitude reports were of limited value to teachers

    - generalizations about classroom conditions that promote problem solving could not be provided from this project

- Students seemed to be more positive about problem solving, took more risks, and demonstrated more confidence as a result of the EQI project.

- Systematic methods for observing students closely — for example, the disposition sheets and extensive answers — helped teachers with teaching decisions and with assessment and evaluation tasks.

- Students responded to the invitation to express themselves more fully and to think about their thinking.

The project activities did not determine to what degree there was an improvement of quality in student work as a result of the use of EQI materials. A further study would be needed to understand more about this relationship.

In conclusion, the project developed some promising approaches to the task of assessing student problem solving. It is a good start, and a basis for people to build from in developing performance assessment measures. The methods of holistic scoring and identifying dispositions contribute to broader measures of assessment that are useful in understanding and reporting on student achievement.

CHAPTER 5: SUMMARY AND DISCUSSION

Action research begins without an end product in mind. The Calgary EQI Project began in just that "open-ended" way. Along the way, the researchers struggled with choosing from a variety of alternatives, answered many questions about assessment practice, and proposed other questions that remain to be answered. This chapter contains 1) findings of the research, 2) processes promoting success, 3) response to the project products, 4) future directions, and 5) recommendations.

Findings

Art and mathematics appear to represent very different assessment challenges, and we did not expect to find many commonalities in teacher practice. However, as the EQI-Art and EQI-Math projects evolved, many commonalities emerged as themes and styles of practice. The commonalities emerged because the making of art and the solving of mathematical problems require complex thinking processes, and their assessment requires informed professional judgement. The expression and development of professional judgement is the common focus of the project conclusions.

Findings that are common to both EQI-Art and EQI-Math are:

- *Quality assessment models in art and mathematics support teacher decision making about teaching and assessment.* The EQI materials were clearly intended for use in assessment practice: as the project unfolded, it became obvious that there was considerable positive impact on teaching practice. This finding supports the view of learning adopted by the project — students create knowledge. The challenge for teachers, then is to become skilled in listening and in observing student work and students at work.

- *Attending to written and/or spoken student reflections illuminates the art work or the problem solution.* Both art and mathematics teachers found that the additional written and verbal explanations provided by students were a new "window to the mind" of the learners. In many instances, teachers found that assessing student outcomes without involving students to explain their thinking was very difficult. Teachers reported that their attitudes and behaviours were changing as a result of "listening" more to students. Advisors suggested that more attention to the student "voice" would be an obvious further development of EQI materials. The importance of language in student art making and problem solving was continually emphasized in the project.

- *Quality assessment is a shared experience between teachers and students, encouraged by shared exemplars and common vocabulary.* Teachers reported surprise and delight at the interest and sophistication displayed when students became involved in their own and peer assessment. Teachers and students require opportunities for joining in discussion and examination of their intended meanings and problem solutions.

- *Qualitative assessment takes time since students must complete a complex assignment and teachers must observe and respond.* The concern with not having time to do assessment of this nature was expressed more frequently by secondary mathematics teachers and was related to a perceived pressure to cover a required amount of prescribed curriculum.

- *Exemplars in art and mathematics performance assessment are a way to share expertise and to develop a sense of connoisseurship.* A collection of quality exemplars in subject areas helps develop high and common expectations for student outcomes and celebrates diversity in student responses.

Informed professional judgement is the critical component in the qualitative assessment of complex student outcomes in art and mathematics. The Calgary EQI Project used the informed professional judgement of expert teachers and subject specialists to develop and refine this project. The materials and approaches that have resulted model the practice of assessment for other teachers and for students.

Processes Promoting Success

The involvement of classroom teachers in all phases contributed to the strength and validity of the project. Teachers contributed expert judgement, thoughtful reflections about teaching and learning, and precise criticism regarding materials and methods. Teachers showed how much they want to work with colleagues on issues of assessment and they reported receiving professional benefits and personal satisfaction from collegial work in this project.

The involvement and commitment of two large school boards provided a wealth of background not only in subject expertise but also in other areas of learning, teaching and assessment. Project teachers valued the opportunity to work with new colleagues. Project advisors all commented on the benefits of working with colleagues in similar positions with another school board.

Response to the Project Products

Teachers and students have responded positively to the materials and approaches developed in EQI-Art and EQI-Math. Chapters 3 and 4 describe in some detail the positive responses of teachers to the activities and products developed within the EQI project. There is some evidence that positive changes occurred in learning and teaching as a result of using EQI materials.

Presentations regarding the EQI project have been very well received. Teacher and administrator groups want copies of the art handbook and mathematics materials to work with in their development of assessment measures. Business people support the focus on significant outcomes and quality work. Parents comment on how the exemplars help them understand expectations. University personnel want to share these approaches with teachers in training.

Future Directions

Teachers and students have responded positively to the materials and approaches developed in EQI-Art and EQI-Math. There is some evidence that positive changes occurred in learning and teaching as a result of using EQI materials.

The development of the EQI assessment materials required time: to discuss, develop, experiment, rethink, assess, evaluate, and to begin again with new ideas that emerge. We were provided with support for three years, and made promising advances. To continue this developmental process requires that more time be dedicated in the future.

Recommendations

At the conclusion of the Calgary EQI Project participants at all levels assisted in the preparation of recommendations for future development of the project ideas and materials. The participants recommended that:

- new assessment processes be implemented into evaluation and reporting practices;
- the *EQI-Art Handbook* and the *Problem Solving Profiles* be published and made available to schools within the CBE, the CCBE, and to other school systems on request;

- institutions involved in teacher preparation include a variety of assessment skills in teacher-preparation courses;
- teachers be encouraged to develop professional collections of quality student exemplars in art and in mathematics;
- teachers be provided with opportunities to work on collegial assessment of student work; and
- school jurisdictions be invited to expand the EQI project process to include other disciplines.

In conclusion, this project reaffirms the importance of thoughtful reflection on the part of the students and teachers in the assessment of student work. It is also clear that innovation requires system support, guidance and time. When teachers and students are informed by experts, connoisseurs and the literature, they have the knowledge and skill to engage in meaningful assessment.

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APPENDIX B

EQI-ART MATERIALS AND REPORTS

Handbook Example

- Sample Lesson from EQI Art Handbook
- One Student Sample from the Lesson
- "Quality Indicators in Art"

Review of Teacher and Student Journals

EQI-Art Pilot Teacher Survey

Lesson 1 Grade 2	Directed Observations and Design: Water Motion

The teacher challenged students to reflect that environments are altered by natural forces and to observe that shapes can suggest movement. Students were to observe examples of the changing patterns created by animals moving through water and to note how light is reflected when water is moving. Using oil pastels, students were challenged to depict movement through water. Students observed many examples from art and from the teacher's picture file. Students had a choice of background and of animal.

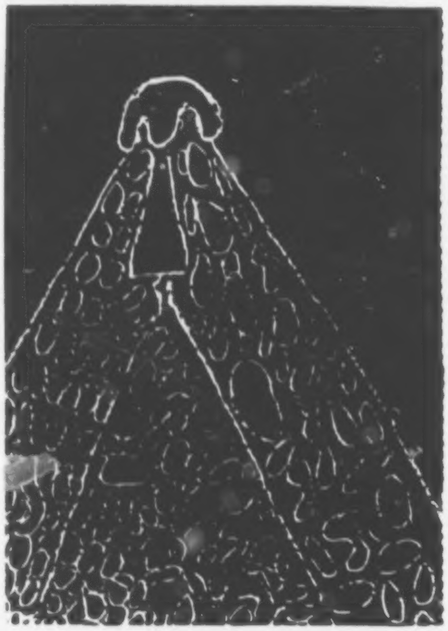
The teacher expected that the students would:

- imagine an animal swimming through water
- create a two-colour oil pastel drawing showing how water changes when an animal swims through
- make patters that show light and shadow on the surface of the water
- indicate the movement of the water's wake

Materials:	coloured construction paper
Medium:	oil pastels
Time:	two 45-minute class periods in the fall term

Student Reflections:

I drew a dog swimming in the water. Whatever is in the water is making a wake coming behind it. The wake makes lines and patterns in the water. I wanted blues so that it would go good and brown to colour the dark.



Observations:

The student has created an unusual pattern of blues, browns and white to show water movement. Shapes have much variety in design, size and placement. The sharp contrast between the pattern in the moving water and the absence of pattern in the calm water creates a dramatic feeling of an animal forcing its way through water.
Repeating diagonal lines, colours and shapes makes unity. The dark shape of the dog placed off-centre creates emphasis, movement and contrast.
The handling of the oil pastel seems confident.

Original work is 12" x 18"

QUALITY INDICATORS IN ART

Meaning

To what degree does the work successfully EXPRESS THE IDEA OR FEELING the student intended?

Relationships

- UNITY: The essential characteristic: everything fits.
  How do all the parts of the work - shapes, lines, colours, textures, values - relate to one another and to the main idea? Consider questions of balance, of warm and cool colours, etc.

- PATTERN: rhythms made by repeating elements.
  What lines, shapes, colours are repeated?
  What variations in repeated elements are noted?
  How do the repeated elements strengthen the idea/mood of the work?

- EMPHASIS: a focus in the work.
  What shapes, lines, colours are emphasized?
  How does the use of emphasis support the idea/mood of the work?

- CONTRAST: shapes show up.
  How does the student use dark and light, hard or soft edges or textures to communicate the idea/mood?

- ELABORATION: significant details.
  Where have details been added?
  How do these details strengthen the idea/mood?

- MOVEMENT/SPACE: lines, colours, shapes, space movements create paths for the eye to follow.
  Is the space deep or shallow?
  How are positive and negative space handled?

Handling

To what degree does the work show confidence, control and flexibility in the use of the materials?

- CONTROL OF THE TECHNIQUE: student has mastered the needed skills.
- FREEDOM AND SECURITY: use of medium - paint, chalk, graphics, etc. - shows confident handling.
- THOUGHTFULNESS: work shows evidence of care and planning.
- EXPERIMENTATION: work shows new uses or several uses of a chosen medium.
- ABILITY TO USE THE EXPRESSIVE CHARACTERISTIC QUALITIES OF THE MEDIUM: softness of chalk, fluidity of paint, sharpness of pen and ink, etc., support this idea.

Educational Quality Indicators Project

REVIEW OF TEACHER AND STUDENT JOURNALS

Submitted to Jane Sereda
April 3, 1992

Michelle Zederayko
Margaret Latta

Considerations

The consideration of the EQI journals provides some insights into the nature of the project on one hand and the difficulties of getting art students to write about their art on the other hand. Use of the journals ranged from abstract ramblings which were very student-directed to a set series of questions which were provided by the teacher and attached to the journal.

At the outset, it was interesting to note that each classroom was notably different in approach and that the student comments appeared to reflect the individual classroom. Student responses ranged from the student who suggested that, "it is quality work because I have put a full four classes into the project," to the student who asserted that, "it is quality work because the shoe looks like the shoe I was supposed to draw." One obscure reference to the quality Indicators Handbook suggested that the student's work was quality work, "because I compared them and they were almost the same." It is assumed that the comparison was between the student work and the work in the Handbook, although this is not made clear in the journal.

The suggestion that being"almost the same" meant that quality had been produced raises some concerns about the role of the Handbook in the classroom. A student producing facsimile works of art because he/she believes it is a sure-fire way to produce quality is a frightening prospect and one which merits further attention. It suggests that, in order for the Handbook to serve a useful function in the classroom, its use needs to be highly mediated by a teacher who is himself/herself comfortable with the idea. Classrooms where the teacher journal suggested a high degree of anxiety (ostensibly due to the fact that the teacher did not feel that he/she was enough of an "expert") also resulted in student journals which tended to be very lockstep in their consideration of the notion of quality in their art. Classrooms where the teacher's and student's journals suggested a high degree of reflection resulted in student comments which did not appear to consider the Handbook. One such student, who was discussing the degree of completion in his/her picture said, "When I look at a picture I ask myself is it really done, and to answer that I compare the image in my head to my picture."

It is hard to accurately assess the merits of the program in the light of journals from students in the lower elementary grades since the task of writing became a real impediment to an accurate recording of the artistic process. Since the concept of reflective practice in the art making process is inherently good, this problem could possibly be circumvented through use of a tape recorder. We feel that the value of dialogue as a means to sense-making cannot be overstated.

Perhaps the most significant implication from a study of the journals was that even at the elementary levels, there was a notable difference in both student and teacher response between classes where the teacher appeared knowledgeable and classes where the teacher appeared to be doing his/her best with limited art training. Teachers with art backgrounds provided their students with a more extensive vocabulary of art terms and, to judge by the kinds of comments appearing in their students' journals, a concurrent understanding of basic art fundamentals. The students in classes where the teacher's journal reflected a strong art background showed a far greater inclination to use their journals as workbooks which contained plans for future works, as well as thumbnail sketches and insightful discussions of past works.

Conversely, student journals from classrooms in which the teacher's journal entries suggested a lack of comfort with the subject area produced substantially different journals. Many of these students wrote very little in their journals and what they did write appeared to be very teacher-directed, albeit with little use of an extensive art vocabulary. That is, these students appeared to write in their journals primarily in direct response to questions posed by the teacher and their responses often did not reflect the same degree of informed thought about the nature of the artistic process.

Thus, the journals would appear to suggest that the EQI Handbook becomes a viable teaching tool in the hands of a teacher who has a fairly high degree of comfort in teaching art. The journals would suggest that a teacher with little art experience is inclined to be either threatened by the Handbook, or to use the Handbook as a type of Art Recipe book.

Teacher comments indicated a desire for more extensive inservicing and support for using the Handbook, and several pointedly suggested that the actual "how to" of using the Handbook effectively in their classes was a difficult practical concern. One teacher, who saw the Handbook as a selection of "model lessons," pointed out that more information on teacher motives should accompany each project in the Handbook. Another teacher raised a cautionary note in regard to the use of the Handbook as the start of a project since it "stifled the creative process because they (the students) think that it is the only model."

Clearly, the EQI Handbook has some exciting, as well as sobering, implications for its use in the classroom. The implication which requires the most thought, however, would appear to be the fact that no handbook, no matter how good or well-thought-out, can replace expertise on the part of the teacher.

Implications

The Art Making Experience

During art making or creating, many students wrote in their journals of being involved with the medium. They described art making as a "thinking," "working," "constructing," "changing," "building" process. Seemingly, the art-making experience required a relationship between the artist and the medium. It was a search for qualities - the perception, selection, and organization of qualities and a responsiveness to them. The use of the journals by art teachers and art students held the possibility for engaging them in thinking, feeling, reflecting, and talking throughout the art-making process. The facilitation of this dialogical sense-making process was the strength of the journal use by teachers and students.

Some journals evidenced progressively much more depth and insight than others. Acknowledging that there were many factors that could have contributed to this, we felt generally that students who had been encouraged to involve themselves in the art-making process, valuing this process over the product, and where an ongoing dialogue was promoted, evidenced greater understanding in their journals. We surmised that the dialogic sense-making process was dependent on involvement, dialogue and community. These are intertwined and dependent on each other as the art form was created. Above all, the teacher's place in making this happen, was central.

Involvement: Inquiry Guided

Individual interpretation should be encourage. Art making is a search that starts with the self. Students that were encouraged to "play" with a medium discovering for themselves the nature of the medium and a solution of their own making, made comments in their journals that reflected greater sense making and a tacit knowing developing . . . "slowly learning more and more about drawing"; "I decided not to add another colour there because I felt it would be a distraction"; "I said no to myself because I decided it would be too much." These same students seemed far less concerned with the end product and more interested in critically reflecting on their own work and others' in progress.

Dialogue and the Place of Community: A Discourse by Nature

A large part of the search process is the ongoing dialogue generated between the emerging art work and the artist. The attention drawn by teachers to quality indicators seemed to encourage students to see the interrelationships of elements with in a whole. It also helped students find the words to verbalize their reflections on their own and their peers' art work. This discourse was greatly facilitated by teachers who responded to their students' work in a manner that continued the conversation rather than shutting it down.

In Conclusion

We saw the journals as holding the possibility for being an excellent means to foster artistic learning. The opportunity for teachers to reflect on their own practices was described by many as "invaluable." Their constant questioning and striving to understand the project was made clearer through their reflections, observations and feelings about their art classes and students. We saw the place of the teacher as pivotal in regards to facilitating the use of the journals in an approach that promoted a continuing and evolving discourse. The students' journals fostered reflection on their art learning, a heightened sensitivity to elements within a whole developed. It is hoped, therefore, that this encouraged quality improvement in student art work.

EQI-ART PILOT TEACHER SURVEY

PURPOSE OF THE SURVEY: This survey is designed to gather information about the art assessment beliefs, practices and concerns of teachers in the CBE and CCSB in order to develop assessment programs and materials for Art teachers. No individual responses will be used in reporting, and you need not identify yourself on the questionnaire.

If you have questions or comments about the survey, please contact Jane Sereda, Educational Quality Indicators Project, Calgary Board of Education, telephone 294-8243.

10 out of 11 pilot teachers (91%) responded to the survey

1. 1990-91 ART TEACHING ASSIGNMENT

Division I (Grades 1-3)	Average	1.5	hours per week Art instruction
Division II (Grades 4-6)	Average	6.5	hours per week Art instruction
Division III (Grades 7-9)	Average	8.0	hours per week Art instruction
Division IV (Grades 10-12)	Average	15.0	hours per week Art instruction

2. NUMBER OF YEARS TEACHING EXPERIENCE - Write the number of years you have taught in each Division on the line below. The mixed Division category is for teachers who have had teaching assignments across Divisions.

E.C.S	Div.I	Div.I/II	Div.II	Div.II/III	Div.III	Div.III/IV	Div.IV
____	____	____	____	____	____	____	____

TOTAL YEARS "TEACHING" ____

Respondents reported from 3 to 25 years of teaching: the average was 14.2 years.

3. NUMBER OF YEARS OF EXPERIENCE TEACHING ART - Write the number of years you have taught Art in each Division on the line below.

E.C.S	Div.I	Div.I/II	Div.II	Div.II/III	Div.III	Div.III/IV	Div.IV
____	____	____	____	____	____	____	____

TOTAL YEARS "TEACHING ART" ____

Average number of years "teaching art" was 12.2 years.

4. NUMBER OF UNIVERSITY OR COLLEGE ART COURSES TAKEN (one full course and one half course would be written as "1.5" courses)

Art Methods	**Average**	**2.4**	courses
Art History	**Average**	**2.4**	courses
Art Studio	**Average**	**8.0**	courses

other Art Courses (specify):

______________________ ______________ courses

5. In the past two school years (since September, 1989) **about** how many hours have you spent **directing in art inservices and/or giving professional assistance** related to the teaching or the assessment of art?

Average 21.2 hours
Range from 10 - 50 hours

6. For each of the following descriptors, please circle the number that represents **the degree to which each describes YOU:**

		very descriptive			*not descriptive*	
a practising artist		1	2	3	4	5
a specialist teacher (in Art)	**n = 8**	**1**	**2**	3	4	5
a non-specialist teacher (in Art)	**n = 2**	**1**	**2**	3	4	5

7. If you had your choice of teaching assignments, would you: (Circle the ONE number that **best represents your choice.**)

a. express a preference to teach Art - **9 out of 10 respondents**
b. express a willingness to teach Art - **1 out of 10 respondents**
c. express a preference **not** to teach Art

If you answer "c," please explain why:

8. Beliefs about Art instruction and assessment are illustrated in the statements that follow. Please read and respond to each of the following statements by **circling the letters that indicate your level of agreement with each statement** on the scale:

All responses from this point on reflect "after pilot" results.

SA = Strongly Agree
A = Agree
U = Undecided
D = Disagree
SD = Strongly Disagree

	SA	A	U	D	SD
a. Art instruction has a significant effect on a student's ability to produce good art work.	8	2			
b. It is important for all students to have quality Art instruction as part of their public school education.	9	1			
c. Innate talent determines how well students perform in Art.	2	6		2	
d. The identification of quality work in Art is based on individual taste.	3	7			

		SA	A	U	D	SD
e.	All students are capable of developing good skills in Art depiction and composition.	4	6			
f.	Art courses should be given the same level of importance as all other courses in the school curriculum.	6	4			
g.	Objective criteria should be the basis for assessing quality work in Art.	4	3	1	2	
h.	It would be helpful for teachers to have common criteria for assessing the quality of student art work.	2	8			
i.	Art courses should be provided with a similar amount of resource support as are other courses in the school.	9	1			
j.	Checklist are more valid than individual critiques in assessing student art.	2	6	2		

There was *very little* change in these answers before and after piloting.

9. The statements below represent **impressions of the status of Art in a school**. Please indicate your level of agreement about how well each statement is representative of the general feelings **IN YOUR SCHOOL** on the scale:

SA = Strongly Agree
A = Agree
U = Undecided
D = Disagree
SD = Strongly Disagree

		SA	A	U	D	SD
a.	Art is an important subject.	4	3	3		
b.	All students should take Art from Grades 1 to 6.	3	5	1		
c.	All student should take Art at least once in secondary grades.	4	3	1	2	
d.	Art is a source of pride for the school.	5	4			
e.	The objectives of the Art program are understood.	3	3	3		
f.	The Art program turns students on.	5	5			
g.	Art is highly visible in the school.	7	1	1		
h.	The Art program receives its share of resources and support.	4				
i.	At our staff meetings, Art receives the same attention as other school subjects.	1	3	2	3	1

There was almost no change in responses before and after piloting.

10. Below is a list of assessment methods some teachers use in Art programs. For each of the methods listed, please indicate **how often you use each method in your current Art classes** by CIRCLING the appropriate term on the right.

Except where noted, there was almost no change in responses before and after piloting.

	ALMOST ALWAYS	QUITE A LOT	SOME-TIMES	SELDOM	ALMOST NEVER
written tests **less after piloting**			1	9	
checklists	1	1	4	2	2
portfolios	6	3	1		
visual journals or sketchbooks	1	3	4		2
written critiques of individual art works	1	2	5		1
verbal critiques of student work	3	6			1
student self-ratings **slight increase after piloting**		2	4		2
peer ratings **slight increase after piloting**		2			
numeric scores on art handed in	1	3	1	1	4
observations of work habits	4	3	3		
other methods I use in assessing Art	2	2	1		

11. Below are various categories teachers use in **marking student achievement in Art courses**. Beside EACH OF THE CATEGORIES, indicate the percentage that category contributes to the report card mark you give students. If you DO NOT use the category, please put in a ZERO. The sum of all entries should be 100%.

	Range	**Mode**
student knowledge of art theory	0 - 50 %	0
student artwork produced	16 - 50 %	20, 50
attitude to the subject	2 - 20 %	10
attendance	0 - 12 %	0
willingness, cooperation	0 - 20 %	10
group work	0 - 13 %	0
creativity/originality	1 - 30 %	20
completion of project on time	0 - 15 %	0
other factors (specify):		

There was little change in responses before and after piloting. A small change was noted in slightly more emphasis placed on "artwork produced" and slightly less emphasis on "willingness, cooperation and attitude" after piloting.

12. Below is a list of factors that may play a role in how you **plan your Art lessons.** Circle the number that indicates the level of importance each factor has on your practice.

There were no significant changes in responses before and after piloting.

	Very Important	Important	Somewhat Important	Of Little Importance	Unimportant
integration with other subjects	4	2	1	3	
the Art curriculum guide	3	3	4		
the Art Resource Guides	3	3	3		
recommendations from school administrators		2	3	4	1
personal collection of successful lessons	3	5	2		
perceived student needs	5	4			
recommendations from colleagues		3	4	2	1
recommendations from system art specialists	4	2		3	
cultural celebrations in the school		3	1	5	
cultural celebrations in the community		2	1	5	1
seasonal art (leaf art in fall)		2	2	4	1
my own judgement as a teacher	6	3	1		
other: (specify)					

____

____

13. Below are a number of activities related to teaching and assessment in Art. Consider each activity and indicate your response by circling the number that best represents your response in relation to the following three questions:

The few changes noted between "before" and "after" pilot responses are indicated below.

What is the **IMPORTANCE** of the activity to good instruction?
1 very important
2 important
3 somewhat important
4 of little importance
5 unimportant

HOW HARD do I work at this activity?
1 very hard
2 hard
3 somewhat hard
4 not very hard
5 not at all

HOW COMPETENT am I at the activity?
1 very competent
2 competent
3 somewhat competent
4 not very competent
5 not competent at all

ACTIVITY	IMPORTANCE					HOW HARD					HOW COMPETENT				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
making up written tests for Art			1	4	4			4	5	1	1	2	3	2	2
writing critiques of student art	1	3	5		1	1	4	3		2	1	5	4		
developing checklists for assessing art works	2	2	4	2		2	2	4	1	1	1	5	4		
explaining the value of art education to administrators/parents	4	5	1			3	3	3	1		3	4	1	2	
explaining report card marks to parents at interview time	3	3	1	3		3	3	2	2		3	5	2		
establishing evaluation criteria for assessing individual student art works	5	5				5	4	1			4	4	2		

*** More competence expressed after piloting.**

ACTIVITY (continued)	What is the **IMPORTANCE** of the activity to good instruction? 1 very important 2 important 3 somewhat important 4 of little importance 5 unimportant					**HOW HARD** do I work at this activity? 1 very hard 2 hard 3 somewhat hard 4 not very hard 5 not at all					**HOW COMPETENT** am I at the activity? 1 very competent 2 competent 3 somewhat competent 4 not very competent 5 not competent at all				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
establishing evaluation criteria for final student marks in the Art course(s) you teach	5	3	2			3	5	2			3	6	1		
planning lessons based on student results in producing art	4	5	1			3	6	1			3	5	2		
planning lessons based on the Art curriculum guide	2	4	3			3	3	4			2	7	1		
providing instruction in the theory of Art	4	2	3	1		2	3	4	1		2	5	2	1	
demonstrating the skills of making Art	7	3				5	3	2			4	5	1		

*** More competence expressed after piloting.**

14. What are the limitations you see in delivering a quality art program in your school?

Thank you for your cooperation.

September, 1991

APPENDIX C

EQI-MATH MATERIALS AND REPORTS

Year One:	Mathematical Dispositions
EQI-Math Year One:	Sample Problems
Year Two:	Disposition Checklist
Year Two:	Inventory for Sample Student
Year Three:	Mathematical Dispositions
Year Three:	Holistic Response Criteria
Year Three:	Sample Anecdotal Record Form
Year Three:	Problem-Solving Practices and Beliefs

Survey of Teacher Participants in the EQI-Math Project

Math Problems used in Piloting

EQI-Math Year One

Mathematical Dispositions and Observable Characteristics

Perseverance

- reluctant to stop, willing to persevere in mathematical task*
- tries different methods*
- not easily discouraged
- works to a goal
- completes work (even when not assigned for homework)
- works for a lengthy period of time on one strategy

Risk-Taking

- not afraid to make mistakes (several trials and errors)
- flexible in exploring mathematical ideas and trying alternative methods*
- asks questions
- positive attitude toward trying new things

Confidence

- confident in using mathematics to solve problems, to communicate ideas, and to reason*
- confident that an answer will be found
- sure of correctness even when explanation is difficult

Motivated

- actively doing something (asking, charting, computing)
- shows interest, curiosity and inventiveness in doing mathematics*

Achieving

- sets goals
- successful in many areas of schooling
- values recognition for accomplishments

Shows Understanding

- knows the meaning of the words in the question
- can state the problem in their own words or picture or model
- knows what the question asks for
- has some idea of the form the answer will take
- recognizes a reasonable answer and discards an unreasonable answer

Communicative

- provides verbal or written explanation of response
- uses mathematical language*
- talks through problems with others
- shares ideas, piggybacks on the ideas of others

Creative

- own problems, formulates problems*
- enjoys finding more than one solution

Strategic/Organized

- looks at problems from different directions
- uses logical approaches, classifies, estimates
- sorts data to see patterns
- applies mathematics to situations arising in other disciplines and everyday experiences*

Reflective

- inclined to monitor and reflect on their own thinking*
- learns from mistakes
- appreciates the role of math in culture, as a tool and as language*

*Indicates terminology used in *Curriculum and Evaluation Standards for School Mathematics, NCTM (1989)*

EQI-MATH YEAR ONE: SAMPLE PROBLEMS

EQI-2

Problem #1

Teacher # _____
Name ___________
Date ___________

SHOW AND EXPLAIN ALL YOUR WORK

Mary Jane saw 5 rabbits.
How many ears did those rabbits have in all?

Mark an X on the face that shows how you feel about this problem.

☺ 😐 ☹

EQI-5

Problem #1

Teacher # ____
Name ________
Date ________

SHOW AND EXPLAIN ALL YOUR WORK

The sum of my digits is 2.
I'm greater than 12.
Who am I?

Planning Board (What do we know? What do we want to find out?)

Doing/Drawing Board (Solution, Diagram, Chart, Grid)

How I feel about this problem ____________________.
Explain ______________________________.

EQI-8

Problem #1

Teacher # ____
Name ______________
Date ______________

SHOW AND EXPLAIN ALL YOUR WORK

Margie is a blonde. Rose Mary is a redhead, and Shirley is a brunette. They are married to Alex, Frank and John, but

(a) Shirley does not like John
(b) Rose Mary is married to John's brother
(c) Alex is married to Rose Mary's sister

Who is married to whom? (Assume that married people like each other.)

Understand ○

Solve ○

Look Back ○

Circle words that tell how you feel about this problem or write your own words.

Easy Challenging Confusing Fun or ________

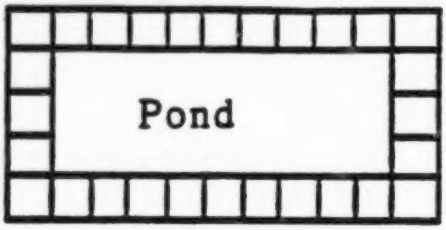
EQI-10

Problem #1

Teacher # ____
Name ____________
Date ____________

SHOW AND EXPLAIN ALL YOUR WORK

1 X 1 paving stones are used to make a border around a rectangular pond. In the example below the pond is 3 x 9 and 28 stones are used.



What are the different dimensions of ponds that would require 36 paving stones to complete the border?

Circle words that tell how you feel about this problem or write your own words

Boring Challenging Confusing Fun or ________

EQI-MATH YEAR TWO: DISPOSITION CHECKLIST

																Student Name	
																1	Confidence
																2	
																3	
																4	
																	Perseverance
																	Risk Taking
																	Understanding
																	Achievement Orientation
																	Motivation
																	Communication
																	Creativity
																	Organization
																	Reflection

EQI-MATH YEAR TWO: INVENTORY FOR SAMPLE STUDENT

What student has demonstrated:	Grade 2 #13	Date and Activity Nov.- Dec./90
1. Confidence in using mathematics	- *low risk with new ideas/concepts* - *confident on ± tasks* - *no confidence in problem-solving tasks, always seems unsure what to do/how to proceed*	
2. Perseverance at mathematical tasks	- *not at problem-solving tasks - sits and looks around, needs to be prompted* - *low perseverance level - shows more avoidance*	
3. Risk-taking in doing mathematical tasks	- *prefers safe, known type of tasks* - *no confidence in new ideas - needs to be prompted* - *won't even really try - prefers to copy partner or tries to avoid doing the task*	
4. Understanding about mathematics	- *appears to have a good basic understanding (noted during calendar time), yet differences arise in new situations* - *lack of confidence affects performance*	
5. Achievement orientation towards mathematics		
6. Motivation to do mathematics	- *enjoys Math* - *does tasks willingly - centers* - *gives impression of liking Math*	
7. Communication about mathematics	- *able to verbalize a task he knows, but usually shy, unwilling to discuss* - *when he is unsure or doesn't know , shrugs shoulders "I don't know"*	
8. Creativity in doing mathematics	- *not obvious/not creative* - *too busy trying to avoid the task*	
9. Organization in doing mathematics	- *organized when he understands the problem* - *relies on others to give clues what to do though*	
10. Reflective about mathematical thinking	- *not really reflective* - *doesn't appear to reflect on what he is doing or what he needs to do in a task*	

EQI-MATH YEAR THREE: MATHEMATICAL DISPOSITIONS

- **Motivated**
    - shows interest, curiosity, enthusiasm and inventiveness in doing mathematics*
    - goes beyond the assignment
    - reluctant to stop*
    - works to a goal
    - works until satisfied with solution
    - works for a lengthy period using one strategy

- **Creative**
    - flexible in exploring mathematical ideas*
    - tries alternative methods*
    - invents own problems, formulates problems
    - able to improvise in selecting materials to represent the problem

- **Confident**
    - belief in ability to use mathematics to solve problems*
    - belief in ability to reason*
    - not afraid to make mistakes
    - belief that problems can be solved
    - ability to identify and use necessary resources
    - prepared to demonstrate for other students
    - belief in ability to communicate ideas

- **Strategic Approach**
    - can state the problem in own words
    - understands the meaning of words in the problem
    - is able to draw a diagram that reflects the problem
    - knows what information is needed to solve the problem and what information is extraneous**

- **Strategic Process**
    - uses organized and logical approaches
    - takes time to stop and think
    - notices and corrects one's mistakes**
    - monitors one's thinking* - is reflective

* Terminology used in NCTM, *Curriculum and Evaluation Standards for School Mathematics*, 1989. p. 228

** Terminology used in Alberta Education, *Diagnostic Mathematics Program*, 1991, "Cognitive Processes."

EQI-MATH YEAR THREE: HOLISTIC RESPONSE CRITERIA

Preliminary Response

- No attempt
  - Words do not reflect the problem;
    - diagrams and drawings unclear or misrepresent the problem; and/or
    - does not indicate which information is appropriate to finding a solution.
  - Begins, but fails to move toward a solution.

Partial Response

- Begins the problem in a manner that could lead to a solution but fails to complete it;
  - omits a significant part of the problem;
  - makes a major computational error;
  - uses an inappropriate strategy for solving the problem.

- Provides a solution, but explanation unclear;
  - argument or explanation incomplete;
  - diagram is inappropriate or unclear.

    (A correct answer with no evidence to support the solution must be further supported by an interview or else there is no basis on which to judge the process.)

Complete Response

- Gives a complete response that includes a full solution with reasonably clear explanations;
  - communicates sound supporting arguments;
  - shows understanding of the mathematical ideas and processes.

Elegant Response

- Gives a complete response with an "elegant" explanation;
  - unusual insight displayed in solution;
  - communicates strong supporting arguments.

EQI-MATH YEAR THREE: SAMPLE ANECDOTAL RECORD FORM

[illegible]
[illegible]

ANECDOTAL RECORD
Problem #1

Student No. 518

+ - 0

(Does not display disposition

Observations:

- Appears to be reading her paper.
- Draws a rabbit, erases it.
- Three rabbits drawn.
- Bending over, looking under her chair.
- Looks around at people in her area.
- Tapping pencil on table.
- Looks around.
- Draws more rabbits, a different view.
- Writes words.

Interpretation:

- Not clear on what she needs to do.
- Sees others drawing rabbits and follows.
- Once they are drawn she is not clear on where to go next.

Recommendations:

- Spend more time helping her to understand what the problem means, what is the question asking.
- Needs more teacher directed model working through.

[illegible]
[illegible]

ANECDOTAL RECORD
Problem #2

Student No. 518

+ - 0

Observations:

- Writing numbers, circles some numbers - 1 2 3 4 5 6 7 8 9 10.
- Gets art eraser.
- Erases all numbers.
- Draws picture of girl.
- Counts girls - 5 - adds more.

Interpretation:

- She didn't understand the problem.
- She felt it should be numbers but then went back to draw a picture because she is familiar with that.

Recommendations:

- Model a similar problem for her.
- Talk her through the words to be sure that it is being understood (ESL student) - greater?

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EQI - Math
Pilot 1991-92

ANECDOTAL RECORD
Problem #4

Student No. ________

Observations:

Interpretation:

Recommendations:

PROBLEM SOLVING PRACTICES AND BELIEFS

Responses at *Beginning and End of Pilot*
October 1991 and January 1992

8 Respondents

- **HOW DO YOU ADDRESS PROBLEM SOLVING IN YOUR MATHEMATICS PROGRAM?**

Pilot Teacher #1

Before Pilot	After Pilot
Not very well! Try to give problems each week, related to material being studied; different from regular text work. We work through the solving once students have attempted them - ideas for strategies from students. I try to model thinking processes. "This is what should/might trigger this approach." References made to Polya's approach - on wall in classroom.	*Not much change here - no time due to incorporation of new M30 curriculum (attention paid elsewhere). Polya model on class wall - attention directed to model as appropriate throughout units. Teacher model - as go through homework, lecture. Student sharing of ideas - good/not so good approaches highlighted (from homework, problem solving, questions).*

Pilot Teacher #2

Before Pilot	After Pilot
Students are made aware that the mathematical principles and concepts taught are mere tools to help people share problems. We set aside one period a week for problem solving. These problems are not from the text but chosen from other sources that have problems of a more stimulating nature. We make sure that throughout the year problems requiring different strategies are used.	*Problem solving is done in conjunction with each topic so that students can see how the topic can be applied. Sometimes I start a new unit with a problem that requires the new topic to be taught, I find the students see the need for what is being taught as well as generates ideas on the new topic. Our tests have one-third of the questions in problem form. This shows the importance we attach to problem solving.*

Pilot Teacher #3

Before Pilot	After Pilot
Problems are presented at different times, in different modes. A concept can be presented and developed with problems reinforcing and extending the concept. Some problems have been given as an investigation to begin teaching concepts. Others are given at random, often unrelated to concept being taught.	*Students have an opportunity to discuss what problem solving is, possible strategies are outlined, and other contributing factors are shared (number of solutions, ways to get solution). Problems are presented to students with support and encouragement to work in cooperating groups. Cooperation and group dynamics is discussed. Problems are debriefed with discussion including all topics.*

Pilot Teacher #4

Before Pilot	After Pilot
Problem solving is integrated into all aspects of math as well as most other subjects.	*Problem solving is integrated into many parts of our day - not just math. "Math" problems are initially presented with children "acting out" the problem. After repeated "acting out," it is then "labelled" with numbers. eventually objects (blocks, beans, etc.) replace the children*

Pilot Teacher #5

Before Pilot	After Pilot
I do not have a regular "scheduled" mathematics problem-solving time. Many opportunities arise naturally that lend themselves to working through a problem. These problems are not always "mathematical problems" but are worked through in a similar way. The advantage of this is that the children are naturally engaged because it comes from their working situations.	*I do not have a defined "problem-solving" time except during the pilot. There are many occasions in math where a lesson which is traditionally taught can be turned into a problem-solving activity. To practise basic facts to 20 they would search for patterns and share with the large group. I have students work on standard and non-standard type problems and discuss "how" each group solved the problem.*

Pilot Teacher #6

Before Pilot	After Pilot
Problem solving is introduced as a unit in September (first week). At this time, a method of solving problems is introduced. The problem solving is then integrated into the other strands of the curriculum throughout the year.	*Problem solving is approached as a group project. Students work in groups to discuss and prepare answers to problems. Problem solving is included in the units taught throughout the year.*

Pilot Teacher #7

Before Pilot	After Pilot
I teach a strategy then give examples. I discuss the Houghton Mifflin daily problems. I use the problem-solving cards (tags).	*I teach a strategy but next time I will give the problem first, let them discover the strategy, then find solutions. Done weekly, then similar problems daily.*

Pilot Teacher #8

Before Pilot	After Pilot
Students are given about 2-3 problems each week. Initially we solved problems together as a class, and then I introduced a marking scheme that I planned to use for problem solving. If students gave only the correct answer, then they would receive 1 mark. Using simpler cases and/or making a table and spotting patterns -2 marks; and 2 marks for finding a general rule and/or explaining why their rule worked.	*Students work on problems based on the current topic as well as 2 to 3 problems per week, which may include logic problems, or problems involving the observations of patterns. Students are required to solve the problems, and provide an explanation about their solution to the problem.*

- **SOME PEOPLE BELIEVE THAT ALL STUDENTS CAN BE TAUGHT TO BE GOOD PROBLEM-SOLVERS. PLEASE COMMENT.**

Pilot Teacher #1

Before Pilot	After Pilot
Good problem solvers **for their ability level.** If a method/model is available (a framework of reference) I believe all students would recognize/demonstrate **some** increase in their ability(ties) to problem solve. (They would benefit if properly taught "how" - just like teachers!!)	*I agree. I believe any student can "pick up" new thoughts/techniques through practise and through teamwork which can aid in the problem-solving process. These new thoughts (processes) snowball with each experience in problem solving. Students recall what's been tried (or done) in the past and try to apply it to the new (even if not correct approach - it at least gives them a starting point).*

Pilot Teacher #2

Before Pilot	After Pilot
Problem solving is not isolated to math. All students have solved problems in their daily lives and how successful they are indicates how happy they are. I try to show them by using more personal problems how Polya's model works and that they can be successful in the math area just as they are in other areas.	*Yes - all students can become good problem solvers. It requires:* • *confidence in one's ability* • *not to be afraid of trying something new* • *the basic skills he or she needs are understood.* *Problem solving is how they will use math later on. I found with a lot of patience and understanding, one can make a student a good problem solver.*

Pilot Teacher #3

Before Pilot	After Pilot
True. Students need to be given experience in solving a variety of problems with development and modelling of strategies as part of the process. Once strategies are understood, practice and experience are needed. Consideration needs to be given to motivation, sustaining interest, acceptance of challenge but not making process a competition.	*Students need guidance and support accompanied by an opportunity to solve problems. Through activities, students learn possible strategies, work using the process and begin to question their knowledge and what to do. Teachers can support, assist and give opportunities to students to become good problem solvers.*

Pilot Teacher #4

Before Pilot	After Pilot
I believe that **most** students can be taught to be good problem solvers.	*I believe the students can be taught the strategies. However, I'm not sure they can be taught to be creative and/or confident.*

Pilot Teacher #5

Before Pilot	After Pilot
I see problem solving linked to thinking. not all people are effective thinkers. I do feel with active involvement, through time, people can change their view of themselves as problem solvers. It is a way of thinking.	*I would now say that some students can be taught to be better problem solvers.*

Pilot Teacher #6

Before Pilot	After Pilot
I agree, if all students are given a method to approach problem solving they can become good solvers - not brilliant ones!	*I agree. All students can be taught to be good problem solvers. The key is building their confidence through exposing them to varied problem types and strategies, and allowing them the* ***time*** *to develop this confidence.*

Pilot Teacher #7

Before Pilot	After Pilot
They can learn some strategies. The slower ones need the most...	*We can teach the steps, but the student must be self-motivated and needs to internalize the strategy. The trying of a strategy needs more structure.*

Pilot Teacher #8

Before Pilot	After Pilot
I believe that if students are exposed to various strategies, and a wide variety of problems, they will begin to think of problems as puzzles and will be able to appreciate the challenge, and experience the thrill and satisfaction when a solution is finally found.	*I believe that all students can be taught to be good problem solvers. This can be done by having students solving problems in groups, sharing ideas and strategies, and feeling comfortable that there is not one way to solve any problem. Students will realize that although their approach may be different, they could also find a solution to the problem.*

- **HOW DO YOU FACILITATE THE DEVELOPMENT OF THE PROBLEM-SOLVING PROCESS IN YOUR CLASSES?**

Pilot Teacher #1

Before Pilot	After Pilot
Not much has been done here.	*Sharing student processes with the entire class. Giving suggestions as to ways of approaching problems (in general).*

Pilot Teacher #2

Before Pilot	After Pilot
We solve problems in groups - this leads to critical discussion of (a) what is the problem; (b) a variety of possible solutions can be suggested; (c) which solution works or does not work and why; (d) what process is required to put each plan into action; (e) how reasonable will the answer be.	*Any problems we have (not only math) are solved using the problem-solving method - example, like preparing for a test, or door-decorating for certain activities. After a while you find they tend to adopt this method for a lot of personal things the students do and when it comes to math the method is well-entrenched and they find it better.*

Pilot Teacher #3

Before Pilot	After Pilot
Sharing strategies. Working through process with students to develop risk-taking, open sessions for discussion (build talk for understanding) and create sense of sharing rather than working in isolation.	*Students need to express their knowledge, become comfortable in discussing and writing about ideas, learn to discuss what and when they don't know, have models to share their strategies and realize they are working on problem solving as a process. Opportunity needs to be given to practise problem solving and sharing successes, misinterpretation and all the real feelings and happenings as problems are worked on.*

Pilot Teacher #4

Before Pilot	After Pilot
Divergent type questions that are open-ended and allow for many possible responses are used (e.g. what would happen if...? How many ways can you...? Can you think of different ways?	*By using the process in as many areas of our daily classroom life as possible.*

Pilot Teacher #5

Before Pilot	After Pilot
Problem solving is daily life in a year two classroom. Problem solving in math develops as we work through problems together and recognize that there are many ways to get an answer. I am conscious of "step-in problem solving" and strategies so I involve the students in a wide range of experiences and through the year to introduce these.	*The discussion after the students have worked out a problem is important. They see how others did it. They rethink how they did theirs. Students then work on a similar problem and can change the way they did it first. Materials and conversations are encouraged.*

Pilot Teacher #6

Before Pilot	After Pilot
Modelling a successful method (Polya's). Reward the use of a successful method. Allow group (triad) problem solving.	*Group work facilitates discussion of strategies and methods to solve problems.*

Pilot Teacher #7

Before Pilot	After Pilot
Students work alone, in pairs, in threes.	*The acceptance of all ideas by me. I try to do problems too. I share my discoveries too. I tell them I confer with others. I don't use an answer key.*

Pilot Teacher #8

Before Pilot	After Pilot
I try to select a variety of problems, which I believe would be of interest to my students. Some may require experiments, or working with concrete materials to see patterns and eventually solve the problems. Hints are sometimes given to the whole class, or I may work with students individually, asking guided questions.	*Problems are given regularly. Students are given the opportunity to work in groups and share ideas and strategies with each other. Students are encouraged to read their solutions to the class, and solved problems are displayed in the classroom.*

- **HOW DO YOU ASSIST YOUR STUDENTS TO GAIN INSIGHT INTO THEIR PROBLEM-SOLVING STRATEGIES?**

Pilot Teacher #1

Before Pilot	After Pilot
Using ideas of strategies to try via other students is the only insight used so far.	*I gave a "debriefing" session (10 minutes) in the class following the problem-solving hour to share what I was seeing with all the students (their approaches) plus how I tried to solve the problem. (What was good, not so good, why some things were better.) Also posted good solutions at back of class.*

Pilot Teacher #2

Before Pilot	After Pilot
After working in groups - each group reports on his solution - we then discuss this as a class and comment upon the solution.	*They work in groups - allows for different strategies to come forward. Groups present solutions to class - again show different strategies other groups used.*

Pilot Teacher #3

Before Pilot	After Pilot
Students begin to understand strategies and their need in lessons specific to strategy development. Through practice and discussions, students share their strategies with others and increase ways of developing more strategies.	*Illustrate, model and discuss strategies, what processes are involved and pose questions to nudge in many different directions.*

Pilot Teacher #4

Before Pilot	After Pilot
Through questioning - asking for explanations.	*Through discussion and idea exchanges.*

Pilot Teacher #5

Before Pilot	After Pilot
I have them share their method of solving and listen to others' ways. Explaining how one has "arrived" at the answer gives many places to engage them in thinking about their thinking.	*I ask questions too about what they are doing. I try to make links to other problems they have worked on.*

Pilot Teacher #6

Before Pilot	After Pilot
Ask them to explain how they reached an answer, or to explain why their answer is reasonable.	*Providing them with various problems that utilize different strategies. Always asking them if a problem can be done another way.*

Pilot Teacher #7

Before Pilot	After Pilot
They explain an answer to the class. "Tell me what you know." I have them make up problems for the class.	*I always ask (not **tell**) "What did you try?" "Can you try....?"*

Pilot Teacher #8

Before Pilot	After Pilot
Sometimes I would list the different methods used to solve a problem, or I would get a student to explain the strategy, he/she used, then ask other students to explain theirs if it was different from the previous one read.	*I assist my students to gain insight into their problem-solving strategies by having different strategies described by students, by displaying different ways in which a problem may be solved and by encouraging students to find other ways to solve problems.*

- **HOW DO YOU MODEL PROBLEM SOLVING FOR YOUR STUDENTS?**

Pilot Teacher #1

Before Pilot	After Pilot
I "talk out" the problems; e.g. with exponent questions "What do I see? What do I think? How do I progress?" I use them to think/be aware of their thinking processes and verbalize and write (in journals).	*Through verbal communication and demonstrations. This is what I tried... This is what I was thinking... This is how I kept track of my thoughts and plans... etc.*

Pilot Teacher #2

Before Pilot	After Pilot
I take a problem that has nothing to do with math and I go through all the stages in Poly's model with them in solving this problem. Example: Inviting a limited number of people to your birthday party.	*Doing problems with them - asking questions that bring out the model to be used. Use this method for any problems we have as a class (making a team for sports events).*

Pilot Teacher #3

Before Pilot	After Pilot
By working through problems with students. Presenting problems that do not have solutions. Brainstorming ideas by sharing and accepting suggestions. Often times problems are sent home and parents invited to participate.	*Discuss everything and anything. Work on problems with students. Facilitate activities. Support and guide students as they work. Pose many varied questions.*

Pilot Teacher #4

Before Pilot	After Pilot
Verbalize a problem I have - walk/talk my way through to possible solutions.	*By using problems that arise in my life as a teacher in the classroom.*

Pilot Teacher #5

Before Pilot	After Pilot
I often think out loud while working through a problem. They see me struggle with "how to" and self-correct a redirect focus; also that this takes time and help from others is appreciated.	*I always encourage students to think of another way to solve everyday problems. When I ask, in math, can we solve this another way, they see it as part of the lesson. I try to help them see problem solving is a life skill and is flexible.*

Pilot Teacher #6

Before Pilot	After Pilot
Presenting problems to the class - solving as a group - using guided questions. Always asking, "Is there another way?"	*Classroom demonstrations by myself and other students.*

Pilot Teacher #7

Before Pilot	After Pilot
I like to show them patterns I have learned. "Look what I found out."	*I do a problem solution with them.*

Pilot Teacher #8

Before Pilot	After Pilot
Whenever students ask questions about any problem, I would usually draw a picture, or set up a table, then ask questions based on the diagram or the table, to try to get students to see relationships, and spot patterns.	*I sometimes show students how to solve a problem using my strategy of drawing a diagram, or using a simpler case based on the problem, and looking for patterns. I also read a problem several times until I understand what is being asked, and I list information given. I do not hesitate to answer questions based on the approach I am using, and to explain why I used that method. I also acknowledge methods that are different from the one I applied to the problem.*

- **HOW DO YOU EVALUATE STUDENT PROBLEM SOLVING?**

Pilot Teacher #1

Before Pilot	After Pilot
I try to use a scale of 5 (holistic marking). Very little has been done by me in this area.	*With difficulty? Followed the 0-1-2 approach of preliminary, partial, complete response (and elegant) but still had difficulties...*

Pilot Teacher #2

Before Pilot	After Pilot
I look for (1) does the student understand the problem; (2) did he make a plan and follow it through; and (3) how original is his solution.	*See last sheet.*

Pilot Teacher #3

Before Pilot	After Pilot
Student evaluation is based on observation and interaction in class -contributions to discussion, participation, interest and work within the process, ability to acquire the language and use it.	*By observation, contributions during discussion, knowledge and feedback in oral and written form, strategies as shared during debriefing sessions.*

Pilot Teacher #4

Before Pilot	After Pilot
When they're working with concrete material I observe and record. Later when they're working at the symbolic and abstract stage, I rely on student products.	*Through observation and some student product.*

Pilot Teacher #5

Before Pilot	After Pilot
I currently do not have a specific way to evaluate problem-solving growth and change. I did watch and note good strategies, who gets frustrated, who sticks with it, who needs more clarification than average.	*The way they reached their answer is what I look at. Also, how they talk about getting the solution. I also like to see what they do when they get stumped.*

Pilot Teacher #6

Before Pilot	After Pilot
With a focused holistic scoring point scale (0 to 4).	*I use a four-point system:* *0 - blank;* *1 - correct answer, no work;* *2 - correct strategy but incomplete, inappropriate strategy - incorrect answer;* *3 - appropriate strategy but wrong answer;* *4 - correct strategy and clear explanation*

Pilot Teacher #7

Before Pilot	After Pilot
Worth 4 points: 1 plan, 1 trying, 2 correct answer. Make a problem = 4 points. 10% of math mark.	*a) 0-1 points for each part understand strategy, answer, explain* *b) Problem of the week - a candy* *c) Tests on similar patterns*

Pilot Teacher #8

Before Pilot	After Pilot
Correct answer only - 1 mark 2 marks if strategy was shown (diagram/table) and recognizing pattern or relationships, and 2 marks for explaining why the rule works/drawing conclusions from the diagrams/patterns.	*I evaluate student problem solving holistically, by giving 1 mark for a Preliminary response; 2.5 marks for a Partial response; 4 marks for a Complete response; and 5 marks for an Elegant response.*

- **IS THERE ANYTHING ELSE YOU WOULD LIKE TO ADD?**

Pilot Teacher #1

Before Pilot	After Pilot
I have done little problem solving in my classroom (with "word" problems). I wish to benefit from materials/ideas from others since I don't have the time/direction to establish materials myself. I'm open to trying something new! I look forward to the **wealth of knowledge** I will gain from this project!	*If students gave a complete problem-solving approach and answered the question, even though the answer was incorrect, I still gave them "Complete Response" rating but I constantly struggled with that.*

Pilot Teacher #2

Before Pilot	**After Pilot**
	I found the journal writing on the students picked very hard - as I was not privileged to what they were actually thinking of -but merely based my opinions on observations which at times are misleading.

Pilot Teacher #3

Before Pilot	**After Pilot**
Problem solving needs to be considered not a separate area of development but an integral process of program. Many teachers group problem solving with strands for development rather than as a process.	*Teachers and students often need to break the bonds of searching only for a solution. Key areas of development the teachers and students need to collaborate on are group dynamics, cooperative learning, metacognition, and the ability to realize how you think to use your abilities most effectively (even recognizing what you don't know), problem-solving strategies and process.* *Word problems are difficult to use at the Grade 2 level as often it is not the problem-solving dispositions you end up evaluating, but rather the student's reading ability.*

Pilot Teacher #4

Before Pilot	**After Pilot**
The very nature of learning mathematics is problem solving. We learn math so we can function in life and that functioning is more than figuring word problems. If math is taught from a problem-solving perspective, then we are teaching math for life and students learn it because it is meaningful and they understand it well as its value.	*This project has made me do more formal problem-solving lessons. It also helped me track students differently. It gave me a more definite way to categorize what I saw.*

Pilot Teacher #5

Before Pilot	**After Pilot**
I thought the anecdotal records were valuable but I'd rather be involved by mediating the student's view of the problem.	*Time is the most important factor in problem solving. Each child must be given time by you, encouraging and guiding them to carry out the problem-solving process. They also need time to develop a method.*

Pilot Teacher #6

Before Pilot	After Pilot
I teach a strategy lesson once a week and give sample questions. The other days I supply cards, etc., for the groups. Before report cards I give sample tests.	*I try to emphasize "Which strategy do you plan to try? Which strategy did you use?" to try to get them to develop a plan.*

Pilot Teacher #7

Before Pilot	After Pilot
I am continually looking for new strategies and interesting problems which would help to make my students better problem solvers.	*I would also like to include interviews into the evaluation process for problem solving. Interviews will help the students to clarify the strategies used, and enable the students to give a more complete solution to the problem.*

- **CAN YOU IDENTIFY ANY WAYS YOU HAVE CHANGED YOUR TEACHING OR ASSESSMENT PRACTICES AS A RESULT OF PARTICIPATING IN THE EQI-MATH PILOT? PLEASE EXPLAIN BELOW.**

Pilot Teacher #1

After Pilot
I see the benefit of private interviews to discuss student progress on an individual basis but still don't see how to fit it in. I continue to model thinking processes (and planning, acting out plan, etc., stages). I have not changed teacher/assessment practises yet, but EQI has opened my eyes to possibilities that I'd like to incorporate - now I must figure out how. The assessment scales are good - quick and easy in general - a checklist would be most appropriate. I found the 6 one-hour sessions were too precious in a semester to really "give up" and still would prefer a more "inherent" approach in the Math 10 program (re: problem solving) - though how? I must still try to figure out. Thank you for the opportunity to be a part of this project. I enjoyed learning! Hopefully, I can now put things into practice (slowly but surely).

Pilot Teacher #2

After Pilot
There are some new wrinkles in my approach now: 1. Letting the students read the problem aloud to themselves, as well as to someone else, seems to help them to understand the question better. Also, the interaction of the two leads to better comprehension and more ideas (strategies). 2. Marking problems using the holistic approach was better received by the student. They find the results more encouraging and are apt to try where before, they were afraid to. Makes them better risk-takers. 3. Has given me a better insight on how they approach problems and what areas of difficulty we must work on.

Pilot Teacher #3

After Pilot

The project brought a problem-solving focus to my class by supplying me with problems. I felt a need to explore, investigate and practise, more immediately, much of what had been discussed in class prior to the project. I was also looking for more innovation to work with students. The area of metacognition arose and became very useful for both me and the students. For students who have not had opportunities to discuss and build understanding, talk assists and improves their ability to formulate ideas and express them in written form. The project increased my awareness and knowledge of group process, group dynamics, problem-solving process, and the use of critical thinking within a realistic context. The students made progress, would identify and discuss what they were about. Sounds like progress for me and the kids!!!

Pilot Teacher #4

After Pilot

I believe I do a better assessment now by using the mathematical dispositions as a checklist guide.

Pilot Teacher #5

After Pilot

I would like to include a problem-solving time where students record their "thinking" as in pilot. This was helpful in assessment. I can see advantages in working on all types of problems. I am sure I have missed many good problems and teaching opportunities. The students may benefit from a more consistent "time" to practise problems in a formal way. It gives a wide range of what has come up in a natural way. I'll have to try it and see. I would continue to use the Holistic Response Criteria to sort responses. It allows you to see strengths and weaknesses.

Pilot Teacher #6

After Pilot

I have realized that discussion in a necessary part of the learning process in problem solving. Students must vocalize their thoughts in order to evaluate their appropriateness. It's somewhat like working at the concrete level, students must hear it to understand it. Another important thing that I've learned is that children need time to digest the problem-solving model. Some children might take hours and, if you try to speed up the process or cut it back, you will inhibit their ability to learn.

I would begin problem solving with lots of problems, talking and very little writing.

Be more conscious of the process rather than the end product. Give them plenty of problems at the beginning of the year and not mark them (no risk involved).

Pilot Teacher #7

After Pilot

I will spend more time on looking for strategy problems. I will vary the strategies more in shorter units than repeat the units.

Pilot Teacher #8

After Pilot

As a result of participating in the EQI-Math pilot, I have changed some of my teaching and assessment techniques. I use a period per week for problem solving in groups, as well as assigning 2 to 3 problems each week for students to work on individually.
I have had short informal interviews for students whose problem-solving skills are at the preliminary and partial response stages. (Hoping to organize a more formal set of interviews next semester.)
I display the students' solved problems each week. I now have materials such as dice, markers, squared paper, geometry sets, tape, geometric shapes, etc., available in the classroom, rather than retrieving them from the cupboards on demand.
I now mark holistically because it gives a clearer picture of the strategies students are using, and I also have a better idea about which students would benefit from interviews.

RESULTS OF A SURVEY OF TEACHER PARTICIPANTS IN THE EQI-MATH PROJECT
MAY 1992

I. PARTICIPANTS

Twenty-four classroom teachers were involved in the development and pilot testing of materials for the EQI-Math project. Sixteen of these teachers helped to develop the materials during the 1989-90 and 1990-91 school years. Five of the 16 were involved for only one year as a result of transfers to different schools and other assignments. Eight teachers pilot-tested the materials during the 1991-92 school year.

A survey was sent to all 24 teacher participants. Seventy-nine percent (19) were returned and processed.

II. PURPOSE

The purposes of the survey were to determine (a) teacher practice in teaching problem solving, and (b) the impact of the EQI-Math project on teaching practice as reported by the participating teachers themselves. Another major aspect of the survey was to determine areas of the project that were particularly successful, and areas that should receive additional attention in the future.

III. RESULTS OF THE SURVEY

A. Teacher practice in problem solving

Teachers were asked to indicate, on a scale of: *none - little - some - much -undecided*, the degree to which they made use of 15 teaching techniques which contribute to the development of student problem-solving skills. Teachers reported that all but one were using "some" or "much" in their teaching practice.

The exception was: ***Having students take problems home, thereby inviting parent participation, which received a rating of "little - some." The others, in order of usage from "much" to "some," were:***

Techniques receiving "much" usage:

- Ask students to explain how they reached their answers.
- Have students working in pairs or groups.
- Illustrate, model and discuss strategies.

- Talk out problems indicating, for example, what I see, what I think, how I would proceed.
- Encourage students to acknowledge methods that are different from the ones they applied to a particular problem.
- Present problems that have more than one solution.
- Provide students with a variety of problems which will require utilization of different strategies.
- Utilize brainstorming techniques.
- Have students present solutions to the class.
- Have students demonstrate to others or to the class. (This received "much" emphasis in Grades 5 and 8, "some emphasis in Grade 2, and "least" emphasis in Grade 10.)

Techniques receiving "some" usage:

- Have debriefing sessions in which students can talk about what was successful or not successful in their problem-solving approaches.
- Apply a problem-solving model to a real-world problem that has nothing to do with Mathematics. (Received "much" emphasis in Grades 5 and 8, "some" emphasis in Grade 2, and "little" emphasis in Grade 10.)
- Work through problems with individual students.
- Have students make up their own problems. (This received "some" emphasis at the elementary level and between "little" to "some" at the secondary level.)

Comments

With the exception of the qualifications noted in three of the items above, there was considerable consistency in the utilization of the 15 techniques among teachers from all grade levels.

It was not possible to collect "before" and "after" types of data on teacher utilization of these problem-solving techniques as a result of participation in the EQI project. However, further study might be useful in determining whether the use of the EQI-Math assessment materials encouraged the increased use of particular teaching strategies. Additional study would be useful in examining the connection between teaching and assessment strategies and student success in problem solving.

B. Impact of EQI-Math on participating teachers

- Teachers were asked to respond to the following statements on a seven-point scale: *strongly agree - agree - agree somewhat - undecided -disagree somewhat - disagree - strongly disagree*:

Participation in the EQI project has been a valuable/useful learning experience for me.

Response:

- All respondents reported in the "agree" categories: 68% "strongly agree," 26% "agree," 5% "agree somewhat."

My involvement in EQI has made me a better teacher of mathematics.

Response:

- 95% responded in the "agree" categories: 58% "strongly agree," 26% "agree," 11% "agree somewhat." 5% (one respondent) was "undecided."

I believe that participation in the EQI project was the type of experience that would be of value to teachers of subject areas other than mathematics.

Response:

- 95% responded in the "agree" categories: 63% "strongly agree," 32% "agree." 5% (one responded) "disagreed."

The problem-solving materials developed in the EQI project are:

a) useful to me

Response:

- 80% responded in the "agree" categories: 37% "strongly agree," 42% "agree," 5% "agree somewhat." 5% were undecided and 11% did not respond to the item.

---

b) well-organized and presented

Response:

- 84% responded in the "agree" categories: 42% "strongly agree," 37% "agree," 5% "agree somewhat." 5% were undecided and 11% did not respond.

---

c) easily understood

Response:

- 85% responded in the "agree" categories: 32% "strongly agree," 53% "agree." 5% were undecided and 11% did not respond.

---

d) appropriate for the grade level(s) I teach

Response:

- 84% responded in the "agree" categories: 37% "strongly agree," 42% "agree," 5% "agree somewhat." 5% were undecided and 11% did not respond.

Comments:

Undecided and non-respondents to the above question might be those who did not see the finalized materials used during the pilot. Pilot materials were not sent to any of the teacher researchers.

- **Teachers were asked:**

To what degree has your participation in the EQI project increased your skills and confidence in the following areas of mathematics, and a list of 7 activities followed.

Response:

- Teachers in all grades reported that participation in the project increased their skills and confidence most greatly ("much") in the area of "**assessment of student growth in problem solving**."

- All of the other areas received a rating of "some" increase in confidence and skills:

    - discussing progress in mathematics with students
    - skills in teaching problem solving
    - knowledge of problem-solving techniques
    - reporting student progress in mathematics
    - using new teaching strategies in mathematics
    - discussing children's progress with parents

MATH PROBLEMS USED IN PILOTING

EQI 2

Problem #1

Mary Jane saw 8 rabbits.
How many ears did those rabbits have in all?

Show and explain all your work.

Circle **one** of the following words you would use to describe this problem:

Boring *Challenging* *Confusing* *Fun*

Circle **one** of the following words that describes how you feel after trying to solve this problem:

Discouraged *Satisfied* *Frustrated* *Happy*

EQI 5

Problem #5

David and Jason are visiting Calgary.

One day while exploring the city they realize they are lost.

David said to Jason, "When we were at the Calgary Tower we were 8 blocks west of the hotel." Jason remembered that after they left the tower they went south 4 blocks, then east for 3 blocks, north for 2 more blocks, then east for 5 blocks.

How far away from the hotel are the boys when they realize they are lost?

Show and explain all your work.

Circle **one** of the following words you would use to describe this problem:

Boring *Challenging* *Confusing* *Fun*

Circle **one** of the following words that describes how you feel after trying to solve this problem:

Discouraged *Satisfied* *Frustrated* *Happy*

EQI 10

Problem #4

A.

Take any four consecutive numbers; multiply them together and add 1.

Take the square root of the number.

Is your final answer a whole number?

Show and explain all your work.

B.

Take the middle pair of numbers and multiply them together.

Compare with your first answer.

C.

Repeat parts A and B three more times and write down a possible rule.

Circle **one** of the following words you would use to describe this problem:

Boring *Challenging* *Confusing* *Fun*

Circle **one** of the following words that describes how you feel after trying to solve this problem:

Discouraged *Satisfied* *Frustrated* *Happy*

APPENDIX D

EDUCATIONAL QUALITY INDICATORS PROJECT:

EVALUATION OF PROJECT UTILITY, MANAGEMENT & IMPACT

July 29, 1992

GAIL V. BARRINGTON & ASSOCIATES
102 Discovery Place One
3553 - 31 Street NW
Calgary, Alberta
T2L 2K7

under contract to:

THE CALGARY BOARD OF EDUCATION

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1.0 BACKGROUND TO THE EVALUATION OF PROJECT MANAGEMENT

The Calgary Educational Quality Indicators (EQI) Project was a three-year action research project (1989 - 1992) funded by Alberta Education to develop indicators of quality student performance in school art composition and mathematics problem solving at the Calgary Board of Education and the Calgary Catholic Board of Education.

The project purposes were defined as follows:

1. To identify indicators of quality work which can be applied in the assessment of student achievement in areas of Art and Mathematics
2. To identify conditions that appear to enhance or limit the achievement of quality
3. To develop strategies for collecting quality student work which include recorded interviews with teachers and students
4. To examine quality work with emphasis on alternative assessment strategies to paper and pencil testing

The project was part of a larger, province-wide initiative sponsored by Alberta Education to build sets or clusters of indicators to use in a broader approach to assessment. A number of other jurisdictions were involved as well, looking at a variety of assessment topics.

The Calgary project focused on assessing performance in the areas of art and mathematics. These subject areas were chosen because of preliminary work which had already been done at the Calgary Catholic School Board in the area of art assessment and because of mathematics expertise at the Calgary Board of Education. Further, it was reasoned that the two areas could allow a unique exploration of the assessment of *product* and *process*. The art project could examine the product of the learning, as much of art education had stressed process in the past, and the math project could examine the process of student thinking, as most math education had emphasized the product, or answer, in the past.

The project design incorporated three phases: development, field testing and pilot testing of quality indicators. Committees of teachers and subject specialists reviewed student work, identified characteristics of quality work, considered alternative approaches for recording assessment information and proposed activities and materials for use in classrooms. Classroom teachers tried out a variety of materials and approaches with their students, materials were revised and then were piloted with other teachers.

The project had a full-time designated director who was located at the Calgary Board of Education. A steering committee, comprised of school superintendents and representatives from Alberta Education provided coordination and leadership. A community advisory committee, comprised of university professors, leaders in the fields of art and mathematics, parent representatives, representatives of the Alberta Teachers' Association, and members of the business community provided a sounding board to test project ideas. Finally, two subject area advisory committees, with specialists from both boards, provided "hands on" decision making for the action research in each area.

The art component of the project culminated in the development of the Educational Quality Indicators Handbook which included colour reproductions of quality samples of students' art from Grades 2 and 5, and from junior and senior high along with teacher expectations for each lesson and student comments assessing their own work. Three quality indicators emerged from the project as observable characteristics to be found in students' work, including *relationships, handling* and *meaning*. Student and teacher journals were used in the pilot test to assist in reflective practice on the part of both teachers and students.

Project conclusions for the art component included the following:

1. Quality assessment practice supports improved art making.
2. Attending to written and/or spoken student responses, reflections and thoughts illuminates the art work.
3. Quality art assessment is a shared experience between students and teachers.
4. Effective art assessment depends on common vocabulary shared by teachers and students.
5. The collection of quality art exemplars emphasizes diversity as an attribute of a quality art program.
6. Expert professional judgement benefits from collegial work.
7. Assessment takes time.
8. EQI Handbook exemplars are a way to share expertise, to develop connoisseurship.

The math component explored the concept of holistic scoring and developed some response criteria including *preliminary response, partial response, complete response* and *elegant response*. A series of students' mathematical dispositions were identified, including *motivated, creative, confident, strategic approach* and *strategic process*. Conditions for the math learning environment were also considered.

Project conclusions for the mathematics component included the following:

1. Teachers report positive changes to their teaching and assessment practices as a result of participating in EQI-Math.
2. Teachers want to meet together to discuss teaching and assessment. The experience of working closely with colleagues is very positively received.

3. Useful materials and practices developed in the project included student dispositions, holistic scoring and the exploration of diverse student responses and quality solutions to mathematical problems.

4. The use of anecdotal records, student attitude reports and generalizations about classroom conditions was not seen as practical, due to time and energy constraints.

5. Students seemed to be more positive about problem solving, took more risks, and demonstrated more confidence as a result of the EQI project.

6. Systematic methods for observing students closely helped teachers with teaching decisions and with assessment and evaluation tasks.

7. Students respond to the invitation to express themselves more fully and to think about their thinking.

Finally, some commonalities emerged about the making of art and the solving of mathematical problems in terms of the complex thinking processes required for each and also in terms of the assessment challenges they present teachers. Common findings included the following:

1. Quality assessment practice in art and mathematics supports teacher decision making about teaching and assessment.

2. Attending to written and spoken student responses, reflections and thoughts illuminates the art work or the problem solution.

3. Quality assessment is a shared experience between teachers and students which is encouraged by shared exemplars and a shared vocabulary.

4. Qualitative assessment takes time for both teachers and students.

5. Exemplars are a way to share expertise, develop connoisseurship, establish common expectations for student outcomes and celebrate diversity of student response.

The evaluation of project management at the local level was mandated to be an independent, third-party evaluation and as such was contracted out to an independent program evaluator.

A series of research questions was developed in collaboration with the Project Director. They were as follows:

1.0 UTILITY

1.1 How useful are the EQI elements to assess student achievement?

1.2 Can they be used for reporting to parents?

1.3 Can EQI materials be applied to other subject areas? If so, what areas?

1.4 How would you model or depict key elements?

2.0 PROJECT MANAGEMENT

2.1 Were the necessary management systems in place to support successful project implementation?

2.2 What impact did the steering committee have on project implementation?

2.3 What impact did the advisory committee have on project implementation?

2.4 Did the partnership of the two school systems affect either project implementation or outcomes? If so, how?

3.0 PROJECT IMPACTS/RECOMMENDATIONS

3.1 What recommendations would you make to improve project utility?

3.2 What recommendations would you make to improve project management?

3.3 What happened as a result of the EQI project that you did not expect?

3.4 What impacts will the EQI project have on education in Alberta?

A series of eleven face-to-face interviews were held with representatives of the two school jurisdictions and Alberta Education. A breakdown is as follows:

Calgary Board of Education	Senior Administration	1
	Project Director	1
	Math Education	2
	Art Education	2
Calgary Catholic School Board	Senior Administration	1
	Math Education	1
	Art Education	2
Alberta Education	Senior Manager	1

The data were compiled and analyzed for content after Krippendorff (1980). The remainder of this report is a summary of responses for each of the research questions outlined above followed by some conclusions.

2.0 RESEARCH FINDINGS

Each of the research questions will be explored in turn. The comments were grouped and analyzed according respondents' areas of expertise (art, mathematics or supervision), and according to employer (Calgary Board of Education, Calgary Catholic School Board or Alberta Education) to search for similarities or differences. Where appropriate, these similarities or differences will be identified.

1.0 UTILITY

1.1 How useful are the EQI elements to assess student achievement?

Generally, respondents found the art EQI elements to be very useful. The art specialists agreed that both the visuals in the handbook and the concepts of *meaning, relationships* and *handling* would be valuable to both the specialist and the generalist. The fact that the student was present for the assessment process and able to talk in a shared language about the artwork was seen to be very positive as insight could thus be gained into how to make that artwork stronger. The distinction between assessment and evaluation was seen as a useful one. However, it was pointed out that some orientation would be required for both teachers and students to interact successfully with the handbook.

The math specialists were divided in their views about how useful the math EQI elements would be to assess student achievement. On the positive side, it was seen that the elements provided some useful language to describe what teachers should be looking for in problem solutions and what dispositions students should exhibit. As one specialist commented:

> *The holistic approach makes us look at the solutions to problems and not just at the answers.*

Another aspect of the project which was considered useful was the opportunity it provided for teacher collaboration.

However, the progress made in the math component was seen as "a first small step", consistent with current thinking in math research, but the project did not provide any conclusive links between student dispositions and exemplary work. As one individual commented:

> *This is not the definitive answer, it is some information.*

Two of the four supervisors interviewed were positive in their responses, the others were more qualified. The elements were seen to be useful because they reflected emerging educational thought about reflective teaching, self-assessment, authentic assessment and performance assessment. As one commented:

> *There are new ways of seeing, new words to use and new ways to gather information.*

However, it was also felt that the materials would have to gain respect on their own merit. Teachers were inundated with materials and would have to see the handbook as instantly useful and applicable if they were to explore it further. It was the belief of one supervisor that math was a higher priority than art for elementary teachers and therefore the art handbook was less likely to be adopted by them, whereas art teachers in high school were specialists and might be more likely to use the elements. Another supervisor felt that the art handbook would be used but that as the outcomes in math were less tangible, they might be less likely to be utilized as a result. The fear was expressed that the issue of institutionalizing project concepts had yet to be addressed and that the lack of involvement on the part of senior administration in both boards was a deterrent to implementation.

Overall, with the exception of the art supervisors from both boards who were positive in their responses, respondents from the Calgary Board of Education viewed the project elements as being more useful than those from the Calgary Catholic School Board.

1.2 Can they be used for reporting to parents?

The art specialists were positive in their views that exemplars of students' art in the handbook would be very useful in talking to parents as it was seen as a good place to begin a dialogue about their children's work. In fact, pilot teachers indicated that this was the case. One teacher had reported a conversation with a parent as follows:

> *. . . he realized for the first time how powerful art is in a child's learning.*

It was felt that the EQI handbook would be used as a model for anecdotal reporting in the future.

The math specialists were divided in their views about using EQI elements for reporting to parents. One felt that a lot more understanding had to be developed about how children learn Math before performance assessment would be an acceptable reporting format or teachers' credibility would be at risk. In addition, this individual felt that parents were not yet ready to deal with the qualitative nature of this approach. The other, however, quoted a pilot teacher who had said:

> *When I did my report cards, I knew my kids better this time.*

This individual felt that looking at dispositions and extended solutions was helpful in reporting to parents.

Generally the supervisors were positive in their view that EQI elements could be used for reporting purposes. They saw both parents and the business community as being open to new forms of assessment. However, probably due to their administrative perspective, they had several suggestions about what would have to happen first. These included:

1. The need for parent partnership in their child's assessment

2. The need for guidelines for performance assessment available to the public

3. The need for public and parent education

They saw a number of advantages to using alternative assessment tools, including parent ownership in the child's assessment, a shared understanding of quality in the community and a means of acknowledging risk taking and alternative solutions, not just correction and control. One supervisor did feel, however, that reporting would have to take a different format from those developed in the project before it would be ready for the public but another hoped that the elements would be used for reporting and commented:

> *Far more parents want this kind of evaluation than do those who want a letter grade. When I show them the richness of information from the kids' "talk" they are positive. With thoughtful discussion with parent groups, it has great promise.*

An analysis by employer group did not reveal any differences in opinions overall between the two boards.

1.3 Can EQI materials be applied to other subject areas? If so, which areas?

This question elicited a number of comments on areas of transfer. Every respondent felt that there were lessons to be learned from the EQI project and that either parts or all could be transposed to other subject areas.

Two of the math supervisors felt that both the quality indicators and the project process could be applied to any subject. As one commented:

> *Teachers of all subject areas need to identify problems for students, get responses, and sit down as educators to look, read, analyze and discuss student responses and to set benchmarks about realistic expectations for certain ages of children. The process to find out about what teachers think about responses can be done in any area.*

In addition, the interaction which had occurred between the art and math projects was seen as an example of transferability:

> *They have words to describe the art and they can now be applied to math. Math could take the reflection component from art. It would be the next step to have kids reflect on their solution and give them the words to talk about solutions (self-assessment). You could take it anywhere. It is valuable to assess the process.*

The art specialists saw a particularly close link between art, writing and social studies. A similarity was seen between the way art was edited and critiqued in the EQI project and the way students' writing can be assessed and edited so that students take ownership of the process. The use of positive exemplars was seen as another transferrable instructional method as was the use of journals to provide the opportunity to capture reflection. As one individual commented:

> *Children are looking for meaning. . . . The insight into students' reflection on their work is very rich.*

Social studies was seen to have a strong link to historical and visual materials so that the EQI concepts of *meaning, relationships* and *handling* were seen to be applicable to culture and environment as well.

The supervisors tended to agree that the EQI concepts were transferrable. In addition, the view was advanced that they related to inter-subject areas as well such as English and social studies where the use of portfolio assessment was already in place:

> *It fits to have them look at dispositions, as the math dispositions are really learning dispositions. Art has developed generic criteria. The invitation to let students assess themselves and to develop criteria about what is successful, to internalize quality standards, show samples, use vocabulary to look at work in progress [all fit].*

It was pointed out that there already were writing standards developed and that different subjects, such as industrial arts, already used samples of finished products as benchmarks. In addition, teachers used holistic indicators to assess project work (e.g., a puppet play for a book report assignment). A close link was seen between math and science in terms of problem solving skills.

To summarize, project concepts were seen to be transferrable to the following subjects (with frequency of comment presented in parentheses):

All subjects	(2)
Language arts	(2)
Science	(2)
Social studies	(1)
Inter-subjects	(1)

However, two respondents had reservations. One felt that the project had developed generic impressions but that each subject area would have to develop specific descriptors. However, this individual did believe that the dispositions and response criteria developed in the math component had some applicability to other areas.

The other respondent believed that a prototype had not yet been pulled out of the project that could be generalizable. While the project had been an excellent experience for those involved in it, the EQI findings could not in their current form find widespread applicability.

An analysis by employer group did not reveal any differences in opinions overall between the two boards.

1.4 How would you model or depict key elements?

This question was difficult for respondents to answer. No one came up with a definitive model for the project. However a number of components were identified which could be massaged into a model which would depict the following:

Student-Teacher Interaction	Students and teachers involved in a meaningful, equal, reflective, critical activity using shared language in order to problem solve and add further understanding

While no one had a complete model, some interesting components were identified which could be extracted for further analysis. These included the following:

- Inter-teacher dialogue, analysis and collaboration regarding student responses
- Samples of exemplary work to develop a shared understanding of quality
- Exploration of communications about problem solving
- Use of journals to explore student reflection to access the richness of student thought (mirrors of the mind)
- The paucity of information provided by traditional paper and pencil testing
- The relationships between the amount of space provided to capture student responses on paper and the quantity of reflective comments elicited

Staff members from the Calgary Board of Education seemed to have more suggestions regarding a potential model than other respondents did.

2.0 PROJECT MANAGEMENT

2.1 Were the necessary management systems in place to support successful project implementation?

A number of positive comments were elicited regarding the management and management systems for the implementation of the EQI project. These included the following (with frequency of response in parentheses):

Quality of Project Direction (4)

The Project Director was cited for her excellent job, sometimes in trying circumstances, in terms of background reading and preparation, keeping everyone on task, writing and editing, and external communications. The project was seen to have run smoothly largely due to her direction.

Adequate Budget (2 pro, 1 con)

The budget was seen to be adequate to run the project by two respondents but the third described it as "bare bones". However, the project was never hindered from lack of money and was even able to produce the art Handbook with costly reproductions.

Adequate Time (2)

The three years were seen to be adequate for project development. There were comments, however, that one more year would have been helpful to disseminate and institutionalize the concepts.

Facilities and Secretarial Support (1 each)

The location of the project in the Calgary Board of Education's head office was seen as helpful in that adequate space and secretarial support were provided. However, it was the view of the project director that she might better have been located on site with one of the project components.

Networking (1)

The housing of the project director in the Calgary Board of Education's Department of Curriculum allowed her to be hooked into a variety of curriculum networks at both the local and provincial level which facilitated the flow of information between the project and its larger environment.

On the other hand, a number of problems related to project implementation were also cited. These included the following:

Turnover in Project Representation in the Math Area (4)

While the art representation and leadership remained constant and strong throughout the project, the math component suffered from the turnover of several members, including the curriculum leader from the Calgary Board of Education and the specialists from the Calgary Catholic School Board. It was felt that the turnover slowed the process, and led to a lack of clarity regarding project goals and boundaries. It was felt that the math team never "clicked" and had less commitment to the project which had a negative impact on project outcomes.

Lack of Involvement of Board Superintendents (3)

Respondents commented that the superintendents of both boards did not take ownership for the project. Despite their involvement in proposal development and the acquisition of funding for the project initially, they were only minimally involved at the Steering Committee level (see below) and did not make the project a high priority. The project director was seen to be on her own with an orphan project to run. This was contrasted with other provincial projects where district superintendents demonstrated ownership and involvement. It was feared that this lack of engagement and buy-in would have an impact in terms of the institutionalization of project concepts.

Lack of Involvement of Project Initiators in Project Implementation (2)

The initial proposal was written by central office personnel from the two school boards, including a member of the Research and Testing Department of the Calgary Board of Education (now the Assessment Team), with consultation from one art specialist. The proposal writers never worked on the project and project advisors had trouble clarifying project goals. Time was lost interpreting what they had in mind and was particularly problematic for the math component.

Project Director Position (1)

The fact that the project director held a term-specific assignment which terminates at the end of the EQI project rather than holding a line position in either board was also seen to be a deterrent to potential future institutionalization of project concepts.

An analysis by employer group did not reveal any differences in opinions overall between the two boards.

2.2 What impact did the steering committee have on project implementation?

A project steering committee was comprised of the two board superintendents, the subject area leaders, representatives from Alberta Education, and the project director. The purpose of this committee was to monitor project developments and receive and approve project reports. Two meetings were held during the initial phase of the three-year project, but then the function of this committee was incorporated into existing advisory committees. The Alberta Education representative helped connect the project with the provincial EQI director for decision-making.

Identification of membership on the steering committee was limited. The various steering and advisory committees were confused in most respondents' minds in terms of both membership and function. The project director's contract stated that she was to report to the steering committee regularly and to receive feedback and advice from the committee. Interim project reports were sent to the provincial co-ordinator as part of the project contract and feedback was received.

One issue which was discussed at the steering committee level was that of qualitative versus quantitative analysis of study outcomes. The provincial EQI initiative advocated a balanced approach to measuring outcomes. The Calgary project focused more on qualitative methods and, therefore, some quantative data which were collected during the project may not have been included in the final report.

An analysis by employer group did not reveal any differences in opinion overall between the two boards.

2.3 What impact did the advisory committees have on project implementation?

There were three advisory committees. One had community representation, and the other two were working committees in the subject areas. As a result, responses varied depending on the perspective of the respondent.

The art advisory committee was seen as having a major impact on the project. The project made decisions about the project, guided implementation, debriefed after project activities, and interpreted results. It was from this level that the action research emanated and the process was seen to work very well:

> *The teachers found it to be a rewarding professional experience to sit with experts and talk about teaching art, methodologies and philosophies. They referred to it as a collegial model and recommended it as a PD model. They then used the same model with the child. The answers were not there at the beginning. Teachers became inventors and researchers and became part of the process.*

In addition, it was suggested at the Art advisory committee that journal writing be incorporated into the project. This turned out to be one of the positive results of the project.

The math advisory committee was also seen to have a major impact on project direction, although this was mitigated to a degree by lack of continuity. The committee was seen as a positive force in the project and committee members were involved with teacher in-services and classroom implementation. It met frequently to react to proposed math problems and student responses. As one member of the team commented:

> *We kept the project going in a current direction in tune with the literature in math education. I don't think teachers would have done that on their own. We were able to stand back and take a look at new directions.*

The third community advisory committee was seen by the project director as a good sounding board to try out project ideas on a wider audience.

It appears, overall, that the two subject area advisory committees were the heart of the project, in conjunction with the classroom teachers and students who implemented their ideas.

An analysis by employer group did not reveal any differences in opinions overall between the two boards.

2.4 Did the partnership of the two school systems affect either project implementation or outcomes? If so, how?

Respondents were positive in their views about the impact the partnership between the two boards had on the project. Positive outcomes included the following (with frequency of responses in parentheses):

> It provided an opportunity for new linkages and networking (6)
>
> It was seen as particularly valuable that teachers from the two boards, who did not know each other prior to the project and who had few opportunities in the past to work together, could come together for professional dialogue.
>
> It was a good example of a partnership (6)
>
> The project gave the two boards a reason to communicate in a positive way in depth about a professional topic. This was seen as a unique experience.
>
> It was a positive professional development experience (2)
>
> Project involvement resulted in an increase in the overall base of expertise among project teachers and advisors.
>
> It allowed two different systems to work together (2)
>
> The two school systems were seen to have very different organizational structures and management styles. The cross-fertilization of ideas was seen as a positive outcome.

There were few negative outcomes identified. It was mentioned that as the project director was housed at the Calgary Board of Education, it necessarily followed that the bulk of project costs were supported by this board. However, it was also noted that staff from both boards contributed equally to the project, equal numbers of students were involved, and an equal amount of ownership was demonstrated.

An analysis by employer group did not reveal any differences in opinions overall between the two boards. Both were equally positive about the experience.

3.0 PROJECT IMPACTS/RECOMMENDATIONS

3.1 What recommendations would you make to improve project utility?

The art specialists had few suggestions for improvement of the project and generally felt very pleased with the outcomes. It was suggested, however, that the art handbook binder format could be improved upon and the suggestion was made that an accompanying video of teacher-student interactions would be helpful as well.

The math specialists reflected on the fact that their component had started at a less developed level of conceptualization than the art component and as a result had farther to go:

> *They were looking at the product. We had to look at the process and had never done much in that area. The product in math is a lot simpler. In art there is no right answer so they had explored process already. We got teachers focusing on the solution as a documentation of the thought process. To improve project utility would be to have kids talk or write about their solutions. Documentation of kids' reflections on their solutions would be the next step for us.*

In fact this individual suggested that another project was required in math to allow continued pursuit of these preliminary findings.

Another respondent asked what would have happened if the students had generated the math questions rather than the teachers, and further, whether or not the teacher-generated questions were the right ones for each grade level. This individual felt that a lot more exploration was required in this area.

Another considered the frustration experienced in participating in this developmental project in contrast to the typical mathematics educator's experience which focused on the bottom line. The amount of time invested in the project with little demonstrable output was a concern.

The supervisors had a number of suggestions to improve project utility from their perspective. These are summarized below.

Ensure implementation at the Calgary Board of Education (4)

Due to both differing structures within the two boards and to recent financial decisions made at the Calgary Board of Education, it was felt that the dissemination of project concepts was threatened at the CBE because of lack of personnel to spearhead the process. As the Assessment Team had not been involved in the project, it was not anticipated that this area would continue the development of the project in the future. The subject area specialists were being reassigned due to budget constraints and so would not be available to ensure that project concepts were utilized. The project director's tenure would be up at the end of the 1991 - 1992 school year and so no further direct leadership was envisioned. It is anticipated that curriculum personnel at the Calgary Board of Education will utilize the findings of the project as they work in their inter-disciplinary team assignments in schools.

On the other hand, the Calgary Catholic School Board was retaining their subject area specialist structure, and four of the sixteen supervisors had express instructions to integrate project concepts and practices into their work.

It was hoped that some sort of partnership arrangement might continue so that CBE teachers could access in-service activities in this area at the Catholic board.

Ensure that support be provided on project concepts (4)

It was felt that very carefully designed teacher support would be required to help teachers work with EQI concepts. It would be important for discussion to be encouraged among groups of teachers, that mentoring programs be set up to allow for on-going dialogues among pilot and other teachers and that principals be provided with learning opportunities so that they could support teachers in this process. The outcomes of this project were seen as a possible basis for a revision of student assessment but the process would have to be nurtured. It was also suggested that parents would require background information and that a parents' primer be developed for use at Parents' Advisory Councils.

Overall, employees of the Calgary Board of Education had more recommendations to improve project utility than did employees of the Calgary Catholic School Board. Not surprisingly, the representative from Alberta Education strongly wished to see project concepts built into practice in the district.

3.2 What recommendations would you make to improve project management?

Responses to this question tended to reflect comments made earlier in the interview process. Two major recommendations were advanced regarding how project management could have been improved, as follows:

Involvement of senior level stakeholders (3)

Lack of on-going involvement of senior management at both boards and Alberta Education was seen as a drawback to project implementation. As a general thrust toward performance assessment is perceived in educational circles, it was felt that this project should have received more attention than it did.

Involvement of project initiators (2)

> While several of the same individuals were involved as in the above recommendation, the lack of continuity of vision between the project designers and the project implementors was also seen as a drawback.

A number of other recommendations were advanced by individual respondents about what might have occurred to improve project management. These can be grouped as follows:

Recommendations about project management

Integrate concepts sooner into other subject areas
Increase number of classrooms involved
Increase interaction time for teachers

Recommendations about the math component

More consistency of vision
Look at a few quality solutions rather than a class set
Review math problems for ambiguity, appropriateness of level of complexity, sequence from simple to complex
Have students develop math problems themselves
Support teachers in developing anecdotal reporting skills
Support teachers in developing consistency when marking
Support teachers in making judgements which are based on agreed-upon criteria

There were no recommendations advanced to improve the management of the art component as the specialists were pleased with the process.

An analysis by employer group did not reveal any significant differences of opinion although views were influenced by internal issues. The representative from Alberta Education wished there could have been more of a focus on the provincial goal of building a set of indicators for widespread use. There was a tendency during the project to lose sight of the provincial context.

3.3 What happened as a result of the EQI project that you did not expect?

The surprises respondents experienced tended to cluster around either process issues or project outcomes.

Unanticipated aspects of the process included the following:

> The push for quantitative data, the later abandonment of it, and the willingness with which math teachers accepted qualitative assessments (3)

Lack of teacher consistency in marking (1)

The ease of the art component coming together and the difficulty of the math component in doing likewise (1)

Unanticipated aspects related to project outcomes included the following:

The journals and the richness of the information they provided (3)

New appreciation for students as artists or collaborators (2)

New ways for students to critique their work and talk to their peers (1)

Increased diversity of student artwork (1)

The impact of using language instead of letter grades in math (1)

The solidarity of findings between art and math (i.e., more generalizable characteristics) (1)

The lack of correlation between the dispositions and achievement (1)

Other administrative surprises have already been referred to in 3.1 and 3.2.

An analysis by employer group did not reveal any differences in opinions overall between the two boards.

3.4 What impact will the EQI project have on education in Alberta?

Respondents' views varied about project impacts. One voice indicated that the project would not have a provincial impact:

> *No. A lot of money was put into it and not to come out with something clear is bothersome. . . . We need to highlight things we learned about student thinking and teacher thinking.*

The largest number of comments were positive in nature. Typical examples are as follows:

> *Hopefully the project had influenced the assessment model in Alberta. It has helped to break down barriers, to bring people out of isolation, and to raise their understanding of the interaction of visual and language.*

> *When the student can articulate why their work is good, then the next time they can work on it and advance it. There was a consensus about vision that made the project successful, the fact that we were able to define quality and its factors.*

> *A lot of teachers said they really learned, that they got to know their students better as individual learners.*
>
> *It was an enjoyable project. We have learned a lot. There was excellent assistance from the teams. They read a lot on assessment and caused us to network with people from other school systems. I wish we had another year.*
>
> *It had a marvellous empowerment effect on teachers.*
>
> *It was a wonderful opportunity for school system collaboration.*

Other comments related to whether or not the products which were produced were worthwhile. Some were convinced of their value:

> *It has already had a substantive impact in the talk in school jurisdictions. . . .Some new language emerged from this project, new demonstrated proof that teachers are reliable knowers and valuable information on student-teacher relationships.*
>
> *This study gives people a tangible example of the theory. We have a product and have practised applying it in concrete situations. It gives people some starting ground to start their own performance assessment.*
>
> *We are giving them tools and exemplars to use. The handbook will make teachers more reflective. Samples of art have been judged excellent by those who know. In math, kids thought in their heads and wrote down the answer. Now we are asking them to write about the process.*

But others had a more qualified view:

> *It depends. If they produce the book, if they produce a video, if they incorporate it into a curriculum package, it will have an impact. It had an impact on all the teachers who were involved. Teachers who used it could substitute, add their own exemplars and collect their own students work. Students liked to see what students before and after them (i.e., younger and older) could do.*
>
> *It depends on how user friendly the final products are. The teachers have so many choices that it has to be exceptional material. It is a quality project but it may be overwhelming for teachers, particularly at the elementary level where they have 7 - 8 subjects to prepare for every day. The art EQI handbook is pretty overwhelming. It is impressive but intimidating. I have a subtle caution at the back of my mind that sometimes teachers want something simpler.*

Others saw the project as just one step in a long progression towards performance assessment:

> *Once the report is published it will be one more piece of evidence to support the thrust towards changing the delivery of mathematics in our schools. We must change it. The project will support movement about how we assess students and I would like it to open the door to dialogue about math and its place in education as more than the third R. It is as important to be literate in math as it is to be literate in language.*
>
> *I would hope it would lend support to those in assessment for valuing the process and the solution as opposed to the answer. Lots of people are pressing to look at this. It becomes a piece of good information that we consider. There is lots of neat stuff around. This adds to the value in math learning. We won't be doing workshops on EQI but we can't help but mention it if we are talking about assessment.*
>
> *We are moving in the direction of performance assessment.*

However, the EQI project was also seen as a positive influence on the acceptance of qualitative research in Alberta:

> *We even had an influence on Alberta Education staff. They wanted numbers and research support. What we were doing was much more subjective and powerful. . . . The way we did it was more of an action research approach. The qualitative research is legitimate and people thought about it. I would hope it would lend support to those in assessment for valuing the process and the solution as opposed to the answer.*
>
> *It is not fast enough for me but it is having a major impact on valuing naturalistic inquiry.*

3.0 CONCLUSIONS

Respondents at the local level felt that the EQI project had resulted in several useful concepts in both art and mathematics which reflect emerging thought in the area of performance assessment. The art concepts and visuals were seen to be very useful in their current format while the math concepts were seen more as a jumping off point for further development. Again, due to the greater advancement which had been possible in the art component, the handbook was seen as a useful tool for discussions with parents, while the math concepts were felt to need further development before they could be discussed with parents. However, it was felt that the dispositions identified and the idea of exploring how students arrived at solutions was already helping teachers understand their students better. Respondents agreed that EQI concepts and the EQI project process could be transferred to other subject areas. Assessment in math and science was seen to be linked as it was in art, language arts and social studies. The potential for assessing cross-subject assignments was seen as another application. None of the respondents had developed a model to depict EQI concepts. Perhaps this is not surprising as these concepts were neither linear nor sequential in nature but were rather interactive and evolutionary.

A number of useful perspectives were advanced with regard to project management. The director was commended for the excellent management of the project. The resources, support and time allotted to the project were judged to be appropriate. Areas which were problematic included the turnover of mathematics personnel on the project, the lack of involvement of senior level administrators at both boards, and the lack of involvement of most of the project initiators in its implementation. The committee structure and membership was not clearly understood by a number of project participants. The steering committee met infrequently, although some policy direction was provided at that level. The community advisory committee acted as a sounding board for the project director. It was at the subject area advisory committees that the action occurred--most project decisions were made here and implementation of project concepts in schools was directed from these groups. In addition, these advisory committees provided the vehicle for the networking which was viewed so positively by all involved. The partnership between the two boards was seen as very positive in that it also encouraged new networks and linkages. The project was described as an excellent professional development activity for all involved.

Recommendations to improve project utility in the art component related to upgrading the binder format of the handbook and developing videos of classroom use to accompany the handbook. In the math component, it was generally felt that the concepts explored and developed during this project should provide the basis for additional research in the future. As one respondent commented, "We need another year." General recommendations related to ensuring that project findings would be implemented at the Calgary Board of Education despite the reorganization planned in the curriculum area next year, and to providing appropriate in-service opportunities for teachers on EQI concepts. Respondents felt that project management would have been facilitated both at the start-up phase and for the institutionalization of project concepts at its conclusion if senior administrators, project initiators and the CBE assessment team had been involved. Unanticipated outcomes identified by respondents related mainly to the unexpected richness of findings and their utility and transferability, as well as to a new appreciation for students as collaborators in the assessment process. Overall, it was hoped that the EQI project would have a positive impact on performance assessment practices in Alberta in general and in the Calgary area in particular. It was also evident that this would take time to accomplish.

REFERENCES

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